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Our Portrait Gallery. IT has for some time been our intention to begin the publication of a portrait gallery of electrical worthies. Our old-time readers will remember the great success that attended the series of portraits published in this journal's predecessor, *The Operator*, and we now propose to make THE ELECTRICAL WORLD gallery a valuable and interesting supplement to the paper. The first portrait, given in this issue, with a biographical sketch, is that of Mr. Edward Weston, recently elected president of the American Institute of Electrical Engineers.

Lighting New York Harbor. FROM time to time the use of electric lights in and around New York harbor has excited much interest and comment, and up to the present hour the only objection brought against the electric light for this purpose is that there was too much of it. The Hell Gate arcs no longer shine, because the pilots complained of their brilliancy, but those of Liberty are still with us, and those on the Brooklyn Bridge though screened waterward, will continue to light up, as they alone can do, the great thoroughfare between the two cities. We are now glad to note that the incandescents are to be given a chance on the buoys in Gedney's Channel, where the European electrician coming in from sea at night will find them bobbing up serenely and curtseying to give him a characteristic welcome.

Incandescent Lamps in Explosive Gases. THE very instructive experiments made by Lieutenant Hutchins, on the explosion of gases by rupturing incandescent lamps within them, while it points to the evident necessity of protecting the lamps well in dangerous atmospheres seems to us at the same time to prove without a shadow of doubt that they are the safest to employ in these very situations. The lamps experimented upon remained perfectly inert in the gases until ruptured, and hence the ordinary protection by suitable screens and by making the bulb of thicker glass ought to answer fully all requirements for safety. Exception may be taken therefore to the conclusion reached by the experimenter that the incandescent lamp is dangerous for use on board ship in situations where explosive gas is liable to accumulate. It would certainly be difficult to devise an illuminant less dangerous in such situations. If there is such an one, will the lieutenant kindly name it?

Defects of the Patent System. IN our last number we gave the decision of Judge Wallace sustaining the comity of the courts in regard to the position that American patents are limited by the term of like foreign ones. Without going again into the details of the suits then brought up, it may be said that such a limitation is injurious and is a defect in our patent system. The bill now being promoted by the National Electric Light Association to change this state of affairs has therefore very general support in all electrical circles. The merits of the other bill, to establish a patent court, are admirably elucidated by the paper read by Mr. G. H. Stockbridge before the Institute, showing how many and how contradictory may be the ruling deliverances upon any single question under the existing methods of practice. A patent court would be the greatest of reforms, a real and lasting benefit to the inventor and all who help his genius to fructify.

Aldermen on Electric Motors. IT is with much regret that we note the refusal of the New York aldermen to grant the Fourth Avenue Railway Company permission to run its cars down town with electric motors instead of horses. Owing to this refusal it will not be able to use its storage cars below Fourteenth street. If the objections of the aldermen were founded on intelligence and a fair comprehension of the subject there would not be much to say, and one could meet them with arguments of a satisfying character, but it seems hopeless to deal with men who object to the use of these storage cars on the ground that they would be dangerous to passengers who happen to have steel nails in their shoes. Such a criticism, which was made at the Board meeting last week by one member, gives likelihood to the story about another alderman who, when it was proposed to introduce a number of gondolas on Central Park Lake, objected on the ground of expense, saying it would be enough to buy a pair and leave the rest to nature.

Telephone Companies in England. THE desire of the English Government to obtain control of all the telephonic service throughout the country, has led the various companies to seek a common ground of negotiation, and this they find to promise best in a combination, "pooling all their issues." In other words, the Government will have to deal with one strong central management, able to obtain good terms, instead of with several smaller concerns, the weakness of some of which would lead them to set a bad example and precedent in selling out for a trifle. In any event, the telephone business in England is likely to go through the same stages of development and of concentration of power that have been seen here. Telegraphy in this country presents a picture of what the field of telephony may be ten years hence, and even in electric lighting there may sooner or later be a movement towards combination, perhaps on a more extensive scale than surface indications foretell. In telephony, at any rate, the drift of affairs is decidedly towards centralization.

A Modern Jack-of-All-Trades. EVERY week now sees some new use found for the electric motor, and in the work to which it has already been applied its service becomes more and more satisfactory. We illustrate in this number two widely different applications, one being the use of the motor in a New England newspaper press room and the other the utilization by the motor of waste water power in a western State to operate mine hoisting apparatus. As though this were not enough, our New York Notes mention the fact that a fashionable manicure down town employs a dainty little electric motor, supplied by current in the ordinary way, to propel her delicate apparatus for buffing, polishing and trimming her patrons' nails. Undoubtedly, electric power, which can grapple also with an elevated train, is the ideal for the skilled work of the light-touched dentist or manicure, to whose parlor the trim and quiet little motor is an ornament.

A Novel Principle in Galvanometers. THERE are few subjects in applied electricity upon which more time has been spent than the invention of indicating and recording instruments. The various forms of ammeters, voltmeters, galvanometers, etc., are sufficient evidence of this. Recently, again, the introduction of the alternating system has brought out a number of instruments designed for this purpose, whose action depends upon the heating property of the current. In one case we have the heat developed, causing the convection of the air, the currents setting a registering wheel in motion. In another case the heating effect is employed in the vaporization of a liquid, the pressure generated being employed as a means for causing the apparatus to move and register. In this issue we add another plan to the list, in which the heating quality of the electric current is again employed as a means of indication. This indicator makes use of the well-known phenomena of the unequal radiation of heat from bodies of equal volume but different superficial area. The unequal expansion obtained in like lengths of the same metal by the passage of equal current through each thus affords a means of indication which is independent of the temperature of the atmosphere and of the metal employed.

Improvements in Quadruplex Telegraphy. WE conclude in this week's issue Mr. W. Maver, Jr.'s, interesting summary and review on "Improvements in Quadruplex Telegraphy." In this series Mr. Maver has compiled and described with his wonted clearness all the most important attempts to increase the efficiency of the quadruplex system; and he has thus shown not only what has been done, but what yet remains for accomplishment in this direction. Notwithstanding the obvious and admitted efficiency of the quadruplex system, it is sure to be still further improved, and in outlining the possibilities, Mr. Maver has rendered a public service. Incidentally, Mr. Maver's article brings out the enormous value of the quadruplex system to the telegraph companies. Taking the average and ordinary value of telegraph lines, the value of the quadruplex to the telegraph companies in money may be moderately put at $11,000,000; and yet the extraordinary thing about it is that this value is represented by phantom lines, lines which actually have no existence. In other words, to replace the quadruplex service by just so many lines would cost the companies $11,000,000. Taking this low basis of valuation, and considering also the fact that at the present time an average efficiency of 85 per cent. is obtained, it will be seen that an improvement raising the efficiency even 1, 2 or 3 per cent. would have a very notable cash value.

The Junior Board of Electrical Control. IT had been commonly supposed that the Board of Electrical Control appointed by the Governor had full and ample powers for regulating the manner in which wires should be run and electric service should be given in this city. That, however, is a mistake, since during the past month we have all seen a Junior Board of Electrical Control spring into existence, clothed with an authority before which even mayors and commissioners quail. This board is made up of Coroner Levy and his jury, who, being given the task of inquiring into a hapless lineman's death, have determined, in preference, to settle the whole overhead wire problem once for all. Like all self-constituted tribunals, the Junior Board knows of no restriction on its powers, and should the wires not disappear forthwith at its command—well, it will know the reason why. Seriously, it is a great pity that so sensible a man as Coroner Levy should spend his own time, as well as that of his unfortunate jurymen, to say nothing of the city's money, in investigating a matter with which he has nothing whatever to do. We advise him to disband his Junior Board of Electrical Control at the earliest opportunity, and to leave the problem with those who are earnestly seeking its solution. He may not believe it, but it is the fact all the same, that the electric light men are far more anxious than he is to see the wires safely housed underground.

A New Alternating Current System. THE prediction made but a comparatively short time ago, that an alternating current motor of an efficiency comparable with that of a continuous current motor would soon be forthcoming has not required a long time for its fulfillment. Methods by which such a motor could be constructed have been clearly pointed out, and their advantages and disadvantages dilated upon; but now, without employing any of those signalized, Mr. Tesla has struck out on a new line of thought, and in the construction of his machine, noted a few weeks ago in our patent record, utilizes a principle of exceedingly broad application. It is evident that as motion is a relative term only, it makes no difference whether the magnet poles be stationary and the armature be moved, or whether the armature be stationary and the poles be moved; nor does it make any difference whether the poles move as a body, or whether the magnetizing force be so disposed that the poles shift regularly and progressively in a stationary mass of iron. The latter is the principle upon which Mr. Tesla's apparatus is based, and the great modifications which it is capable of in transformers and motors of various kinds are well shown in his paper read at the annual meeting of the American Institute of Electrical Engineers. That which will perhaps attract most general attention, and which is specially dwelt upon by Mr. Tesla, is the fact that the motor requires no commutators, nor does the armature in fact require any connection with the line whatever, as it consists simply of an inductive device mounted in bearings. As an exposition of the principles and theory of this new system of applying alternating current to various uses, Mr. Tesla's paper is remarkable for its thorough and comprehensive nature.

"ELECTRICAL WORLD" PORTRAITS.—I.

EDWARD WESTON.

Mr. Edward Weston, who has just been elected to the presidency of the American Institute of Electrical Engineers, is known throughout the world as an electrical inventor of the first rank. He was born in England on May 9, 1850. His earliest tastes and impulses were in the direction of scientific research, and it may even be said that the perusal of Smee's *Elements of Electro-Metallurgy*, which fell into his hands when he was only nine years old, gave the direction to his career, as from that time dates his interest in, and study of, electricity in its various branches. By the time he was 16 years of age he had acquired such familiarity with the phenomena of electricity and such a variety of apparatus, that he was enabled to give with success a lecture on the subject. Shortly following this, at the desire of his parents, he began the study of medicine, but his leisure was still devoted to his favorite studies in science. After three years, Mr. Weston found the medical profession to be less and less inviting, and he resolved to take a new departure, not only by giving himself entirely to scientific and mechanical pursuits, but by beginning again in a new world. He thereupon left England for New York in the month of May, 1870. Arrived here he soon found that letters of introduction go for little; everything depends upon the man himself. It was not long before his great ability and energy were recognized, and he was soon found in the position of chemist and electrician to the American Nickel Plating Company doing business in this city, where at once his inventive genius and his powers of close observation and analysis were given ample opportunity of exercise. Mr. Weston was, from this connection, actively identified with the early growth of the art of nickel plating.

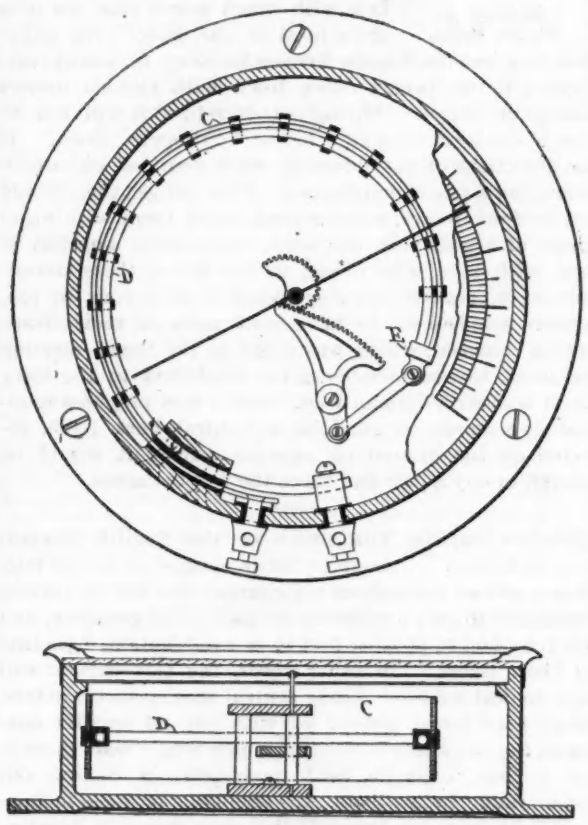
A great many of the processes that are now resorted to in the preparation of the work are those which he has devised. The results of his investigations soon led to the securing of a better adhesion of the metal, to the simplification of many of the details of work, to enhanced economy of material and labor, and to an infinitely superior product. Had Mr. Weston covered some of his best inventions in this department by patent, they would undoubtedly have proved sources of very large income.

Some time in 1872, developing ideas that had long lain dormant in his mind, he began the study of dynamo-electric machinery. with the object of utilizing it in electro-metallurgy, and as early as 1873 he appears to have reached a very clear conception of the sectional armature, upon which, by the way, a patent was granted him about five years later in this country, subsequently to the obtaining by him of a similar patent in England. In 1873 also he prepared the first copper-coated carbons, which are now so familiar to every one engaged in electric lighting. Those which were thus treated by him, however, were of the old obsolete kind, ½ or ¾ of an inch square. In 1875 he removed from New York to Newark, N. J., where he has ever since lived, and there he formed a co-partnership for the purpose of manufacturing dynamo electric machinery, opening what is believed to have been the first factory in this country devoted exclusively to that class of apparatus. Such was the growth of the business, that in 1877 a corporation, called the Weston Dynamo-Electric Machine Company, with a capital stock of $200,000, was organized to carry it on. The old machine then made may have since been improved upon in various respects, but to it belongs the credit of having been a pioneer in revolutionizing the art of electro-metallurgy, replacing the troublesome galvanic batteries, and effecting an enormous saving in every department of the work.

While engaged in this interesting field of electricity, Mr. Weston had not been unobservant of the problems that presented themselves in the utilization of electricity for lighting and the transmission of power. As early as 1875 he began a series of experiments in arc and incandescent lighting. In 1876 he constructed a number of incandescent lamps, and it is an interesting fact that some of the globes for these were blown at the Philadelphia Centennial Exhibition. Mr. Weston's early connection with lamps made on the flashing method, or that involving the hydro-carbon treatment, is familiar to all our readers, and has its place in all the technical and historical books on the subject, as well as in the records of long and costly litigation. It was at this period that the business of electric lighting began to assume shape, and it was not long before a large amount of capital was pledged to the development of Mr. Weston's systems of lighting, both arc and incandescent. In 1881 the Weston Company consolidated with the United States Electric Lighting Company, when Mr. Weston became the electrician of the company, a position which he continued to hold until a few months since, when he severed his connection.

As the result of his incessant efforts to improve and develop the application of electricity, Mr. Weston has taken out about 200 patents, and has at the present time a large number of applications pending. These patents relate not only to the departments already spoken of, but to electric motors, the electrical transmission of power, and electrical measuring instruments. As far back as 1878 Mr. Weston's motors were used in the propulsion of torpedo boats, and to-day Mr. Weston continues his study of this branch. To his intimate acquaintance with chemistry is due his invention in connection with the preparation of tamidine, on the processes for producing which Mr. Weston has a number of fundamental patents. Tamidine, a modification of the substance known as cellulose, is obtained by Mr. Weston from gun-cotton in a perfectly homogeneous condition, resembling thin sheets of gelatine. This material has a wide application, but its special use has been in incandescent lamps since, when carbonized, it possesses very high specific resistance, elasticity and toughness. At the present time Mr. Weston is devoting his energies to the production of several new electrical instruments, such as voltmeters, ammeters, electro-dynamometers, etc., for scientific, as well as practical work. These instruments will have a much wider range of measurement than is customary, and it is believed by all who have had the pleasure of seeing what Mr. Weston has already accomplished in this direction, that the instruments will add greatly to his reputation. In fact, it is thought that Mr. Weston's genius will secure for his products in this department the same welcome abroad that has already been accorded to his apparatus for lighting and power.

Mr. Weston's investigations and experiments are all carried on under his personal supervision, in one of the largest private laboratories in the world, which he has built immediately in the rear of his residence in Newark, and which is equipped with tools and appliances of the very finest description. Here, when not engaged away from home on expert work, for which his services are increasingly in demand, Mr. Weston is almost always to be found, unless he happen to be in his magnificent library,



FIGS. 1 AND 2. A NEW GALVANOMETER.

which comprises not only the best technical literature extant, but one of the choicest collections of rare electrical books and a large number of valuable autographs.

Besides being president of the American Institute of Electrical Engineers, of which he was a charter member, and one of the vice-presidents in 1884, Mr. Weston is a fellow of the American Association for the Advancement of Science, a member of the Academy of Sciences of New York, a member of the American Society of Mechanical Engineers, and a member of the New York Microscopical Society. These affiliations give, however, but a faint idea of the wide range of Mr. Weston's tastes and sympathies. It would, in fact, be difficult to name a branch of modern science and technical practice of which he is not well informed, or upon which he has not made his mark.

A New Form of Galvanometer.

Among the many different devices proposed for the purpose of indicating current strength or controlling circuits is that of the differential expansion bars, whose action depends upon the variable degree of expansion, under the influence of heat, of different metals. This device is well known and employed largely as a thermostat.

The objection to the use of such a device as a current indicating instrument is that it is affected by the temperature of the surrounding air, and when used in instruments of any degree of delicacy they must be adjusted according to the temperature in which they are used, or some compensation must be made for the differences of position or deflection which varying temperatures cause.

In order to avoid this difficulty Dr. Wm. E. Geyer and Mr. W. H. Bristol, of the Stevens Institute of Technology, Hoboken, N. J., have hit upon an exceedingly simple and ingenious device, similar in character, but which makes the indication of the instrument entirely independent of the surrounding temperature.

This is accomplished by the employment of a compound arm or bar consisting of but a single metal, the two arms of the bar being joined at one end, but insulated from each other through their length. The distinguishing feature, however, consists in the fact that the two arms are made of such relative shape and size as to be differently heated and expanded by a current of the same strength passing in series through each. The manner in which this simple arrangement is applied is shown in the accompanying illustration, Fig. 1, which represents the galvanometer, in plan, Fig. 2 showing a cross section of the instrument.

As will be seen, the compound bar consists of a wide strip of metal *C*, of German silver, for instance, and of a wire *D* of the same metal. These two pieces of metal are insulated from each other, and their free ends are connected to the binding posts, near which also they are firmly held in place so as to prevent movement at that end. At the end *E* the two arms of the bar are connected together, and at this point also connection is made with the indicating gear. It is evident, therefore, that by this arrangement a given current passing through the strips in series will raise the temperature of the wire *D* more than the strip *C*, on account of the greater radiating surface of the latter. Hence the wire *D* will be expanded more than the strip, with the result of bending or deflecting the bar, which will tend to straighten out.

As the indications of the pointer on the scale would not ordinarily be proportional to the movements of the expansion bar, the gearing is so arranged that the deflections of the pointer shall be in direct proportion to the strength of the current passing through the compound bar. It is evident that the apparatus is independent of the surrounding temperature, since both parts of the bar are equally and similarly affected by any external changes of temperature. Since, also, the heating effect of the current is employed as a method of indication, the instrument is well adapted for registering the strength of alternating currents as well as continuous, and in connection with suitable clockwork may act as a current register or meter.

Meeting of the New York Electrical Society.

At the last meeting of the New York Electrical Society, held on May 25, Dr. Otto A. Moses delivered a lecture on "The Phenomena of the Alternating Current." The lecturer started out with the proposition that there existed no essential difference between the continuous and the alternating current, that their effects were practically alike, and that they differed only in the character of their relative direction. He then reviewed the history of the generation of magneto electric currents, and finally showed the wonderful applications which the discovery by Faraday of the properties of the induction coil had had in the remarkable developments of to-day. Dr. Moses then described the various forms of apparatus for transforming high tension into low tension current, and demonstrated the rules by which the ratios of lengths for the two windings could be calculated. He also showed the remarkable property of an induction coil having a complete magnetic circuit, in that it entailed no expenditure of current when the secondary circuit is open, the counter electromotive force being then almost equal to the direct. The lecturer was listened to with great interest and received a hearty vote of thanks.

Long Distance Telephone Transmitter.

To the Editor of The Electrical World:

SIR: Will you please describe in your journal the long distance telephone and its working parts. I have put one together and am told that it is like the one in use now. I have never seen the working parts of the receiver or transmitter for long distance telephony.

NEW HARTFORD, Conn. G. W. S.

ANSWER.—The long distance telephone transmitter now employed is similar to the "Hunning's" transmitter, in which the carbon is in the shape of granules. This apparatus has been described by us and descriptions of it can also be found in various books treating on telephony. The telephone receiver employed does not differ essentially from that in general use.—EDS. E. W.

Heating Magnets.

To the Editor of The Electrical World:

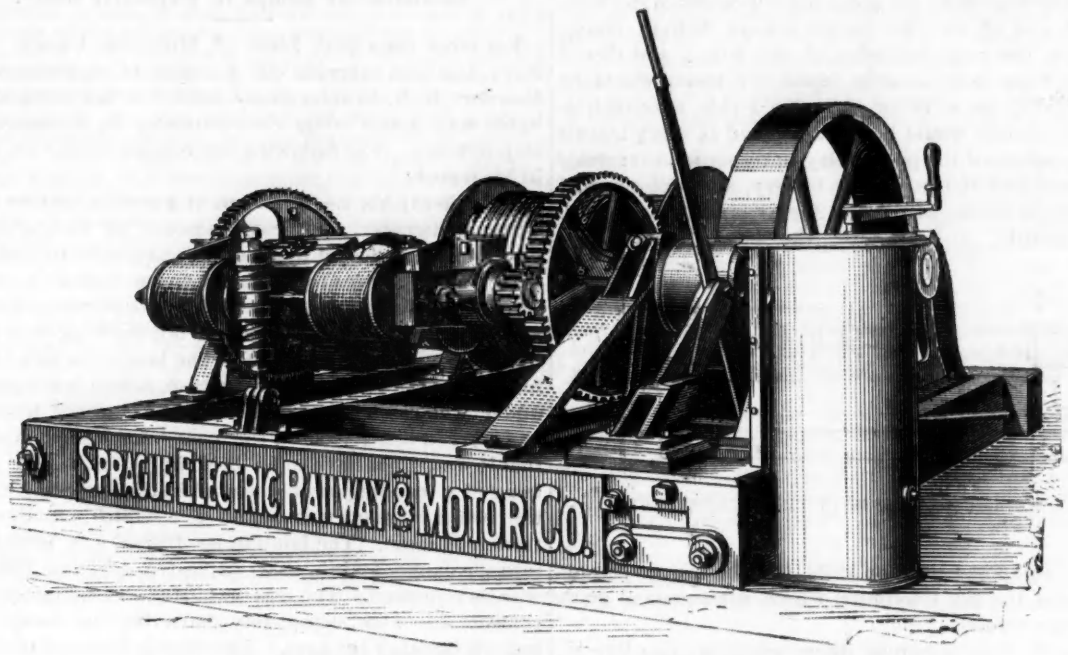
SIR: Please answer the following queries in the columns of your valuable paper: 1. What is the average electromotive force of the Leclanché battery, either "prism" or "disque" type? 2. It is a well-known fact that a certain degree of heat will destroy the magnetism of a steel magnet, that is, if applied to either pole. What will be the effect of heating to a red heat the centre or neutral point?

EASTON, Pa. W. W. L.

ANSWER.—The E. M. F. of the Leclanché cell is 1.48 volt. 2. The effect would be the same as if the magnet had been temporarily broken in two pieces; that is, there would be a pole at each end and two others at the points forming the boundary between the heated and cool portions of the magnet. If the heating has not extended to the ends, these internal poles will disappear on the cooling of the bar, which will exhibit the same magnetic poles as before the application of the heat, but it will not be so strongly magnetic as before.—EDS. E. W.

Mine Hoisting by Electricity.

The great possibilities of electric power in connection with mining operations have already been pointed out by us; and the mine hoisting apparatus, as well as the mine railway, will be eventually driven by the same power. An interesting application of the latter nature has just been carried out by the Sprague Electric Railway and Motor Company, at Aspen, Colo., which shows well the ease with which the electric motor can be applied to this purpose.



OPERATING A MINE HOIST BY ELECTRIC MOTOR.

As will be seen in the accompanying illustration, the hoisting machine consists of the usual drum mounted on a shaft carrying a friction wheel. Another parallel shaft carrying a paper-faced friction pulley bears against the iron face of the friction wheel. For reducing the speed, intermediate gears mesh into pinions on each end of the armature shaft, close to the axle-boxes of the driving motor.

The motor pivots around this intermediate shaft and at its other side has a spring support formed by a bracket bolted to the general base frame of the apparatus. This bracket supports in trunnions a vertical bolt, around which the springs are placed, one above and one below an eye bolt screwed into the pole piece of the motor.

All shocks, due to sudden changes in direction, or intensity of force required, are taken up by a slight oscillation of the motor against the springs. The armature pinions and intermediate gear teeth being thus relieved of this strain, all wear and noise of teeth are thus kept at a minimum.

The reduction of speed from the armature shaft to the intermediate shaft is about one to six, and the reduction from this to drum shaft about the same. As the motor is of 10 h. p. capacity, it is readily seen that such reduction permits of a very great lifting effort. The speed of the armature can be varied, the motor being series wound; and the direction of rotation is reversible by an instantaneous movement of the switch handle, shown at the right. The speed may be varied independently of the load, by manipulation of the switch, which throws the coils of a compound field into various combinations.

The control of the drum is effected by throwing the friction wheels in and out of gear, by braking the large friction wheels against a shoe brake placed beneath it, and operated by the same lever, which controls the eccentric, and by variation of the motor activity, as above described. By these means the most delicate control in handling the heaviest weights is secured.

The normal voltage on which the motor will be run is 440. For the supply of current, a special dynamo installation and a line one mile long has been made at the falls of the Roaring Fork, Grand River, Aspen, Colorado.

Two hoists of this class are to be operated on this circuit, beside a Sprague 10 h. p. motor of standard shape, but wound for 440 volts, which is to be used for general miscellaneous service.

This utilization of water power in Colorado has been made under conditions existing at the mining incline hoist, which, as all miners know, are most exacting. Absolute instantaneous control is required here, and has been obtained.

This electric installation takes the place of an expensive steam plant, with all its disadvantages.

Note on Electric Shock in Dreams.

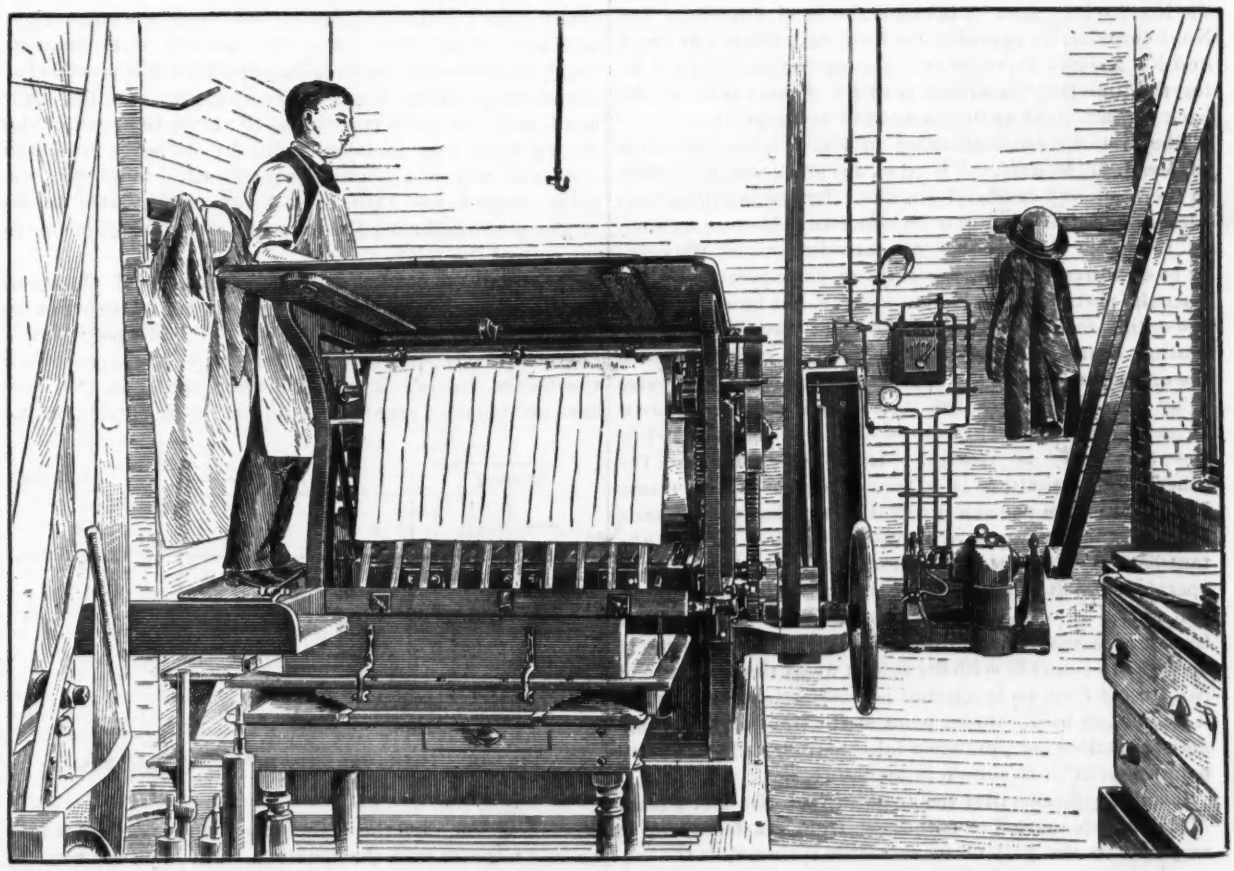
BY E. P. ROBERTS, CHEYENNE, WYO.

I have never seen published any account of the effect of a dream respecting the taking of an electric shock. The following I believe to be authentic, as it happened to me:

One day, three years ago, I had occasion to "monkey" with a Brush manipulator for charging storage battery. The charging current from a 65-light Brush dynamo of 3,600 volts, was "on," and I stood in mud soaking through my shoes. I touched a bare spot—and sat down with considerable force, my arm flying out seemingly with infinite power, almost dislocating it. During the following night I dreamt that I had taken a shock, and the effect upon my muscles was exactly the same, my arm flying out, and my room mate receiving a blow which was stated to be very uncomfortable, and the jar from which awakened me.

The Electric Motor in Newspaper Offices.

In April of 1887, a Thomson-Houston motor of 3 h. p. was installed in the office of the Lowell *Daily News*, replacing a boiler of 5 h. p. and an engine of 4 h. p., of which the users said: "Besides not fulfilling all claimed for them by their makers, they have been, like all boilers and engines, a constant source of expense and annoyance, while their refuse was nothing less than a nuisance to the printing office." The motor occupies about two square feet of floor space, and is found by the proprietors of the paper to be entirely satisfactory in its economy of power as well as of space, in addition to being thoroughly successful in its operation. Since the time mentioned, the motor has been running daily, furnishing power for six large presses. It has never given any trouble and has never needed any repairs.



DRIVING A NEWSPAPER PRESS-ROOM BY ELECTRIC MOTOR.

We understand that the Thomson-Houston Company is meeting with great success in the introduction of motors for this class of work throughout New England, in connection with its numerous central stations there established. This need not be wondered at in view of the great cleanliness, convenience and cheapness of the method and appliances.

The Variation of the Coefficient of Self Induction.

At the last meeting of the Physical Society, Mr. W. E. Sumpner read a paper on the above subject, in which he pointed out that the coefficient of self induction of a coil whose magnetic circuit is wholly or partially composed of iron is a variable quantity, and should be defined more exactly than has hitherto been done. It is the ratio of the induced electromotive force to the rate at which the current is changing, and since the induced electromotive force is equal to the rate at which the magnetism is changing, the ratio in question is the rate at which magnetism changes with the current. From this it follows that if a curve be drawn whose abscissæ represent the current, and whose ordinates represent the amount of magnetism, or the number of lines of force through the coil, the coefficient for any particular current will be represented by the rate of slope of this curve. The shape of these curves is well known from the researches of Professor Ewing, Dr. Hopkinson, and others. The curve slopes generally very little at first, but becomes more and more steep as the current increases. When the iron becomes saturated the curve bends over again, and the slope becomes ultimately very small. When the current is diminished, the curve of magnetism, owing to magnetic hysteresis, does not return on itself, but becomes steeper and steeper as the current is diminished. The coefficient of self induction for increasing currents should therefore at first increase and afterwards decrease, while for decreasing currents it should be small at first, but steadily increase as the current is brought towards zero. Many experiments made on an electromagnet, on the field magnets of dynamos, and on a Kapp transformer, have completely confirmed these conclusions. Owing to magnetic hysteresis, the number of lines of force inclosed by the coil will depend not only on the current flowing at the moment, but also on those that have been flowing previously; and for the same reason the coefficients will depend on the previous history of magnetization, and may be obtained of almost any value by previously using suitable magnetizing currents. The hysteresis in the case of the Kapp transformer was very marked. If the coefficient is variable, the time taken for a current to rise to a given fraction of its steady value will depend on the amount of this current. If the final current is large, it will rise to its full value much more rapidly than if the final current is small. If the electromotive force is only such as to maintain a small current, the current will increase most rapidly at first, and with less and less rapidity afterwards. If, however, the final current is large, it will increase rapidly at first, more slowly afterwards, then with great rapidity, and will attain its final value slowly. When the steady current is large enough to magentize the iron far beyond saturation, this effect may be very marked, and has actually been observed experimentally by Professor Thompson. The general effect of the variation of the coefficient of self induction is to introduce ripples into the curve obtained on the assumption that the coefficient is a constant and equal to the mean of the different values. It is generally assumed in calculations connected with alternating currents that the electromotive force of the dynamo is a sine function of the time, and that the coefficient of self induction is a constant. These assumptions are supposed to be sufficiently true for practical purposes, but the author considers this doubtful.

Experiments made on the Ferranti dynamo at the Central Institution have shown that the electromotive force curve is such that its ordinates differ from those of the most favorable sine curve by as much as 10 per cent. It it probable that with some dynamos the curve of electromotive force consists of the sum of two sine curves, one with a period corresponding with the current alternations, the other having a small amplitude and a period corresponding with the revolutions of the dynamo. This will occur if there is any want of symmetry in the machine. Whenever this occurs the effect of induction will be to magnify the sine wave of large period in comparison with the wave of short period, as Prof. Perry has pointed out, and the consequence will be that the current curve will differ in a marked degree from a simple sine curve, since any want of symmetry in the dynamo will be much magnified, especially at high speeds. That alternating currents are not generally simple sine waves seems to be indicated by the well-known pulsations to which electric lights fed by alternating currents are subject. These pulsations are too slow to be due to the ordinary current alternations, but might be in time with the revolutions of the dynamo.

Although it is well known that self induction always delays the rise and fall of currents, it does not appear to have been noticed that it may, under certain circumstances, hasten the discharge of a condenser. If the plates of a charged condenser be connected by a wire, the discharging current has both to rise and fall. The effect of self induction is to delay both. It always delays the fall of the current more than the rise, because while the current is rising the condenser is far more highly charged. If the self induction be not too great, the condenser will discharge quicker than when self induction is not present. It is always possible to half the time the condenser takes to discharge by using a suitable amount of self induction. As a lightning discharge is essentially the same as the discharge of a condenser, it seems likely that a lightning conductor of iron will be better than one of copper, because the former has more self induction than the latter. Dr. Lodge has recently shown experimentally that the iron conductor is the better of the two, but the author does not consider his suggested explanation as necessarily the right one.

Improvements in the Quadruplex.—III.

BY WM. MAVER, JR.

All of the foregoing described devices excepting that of the repeating sounder may be classed as main line arrangements.

Those remaining to be described are local arrangements which seek to bridge over the moment of no magnetism in the No. 2 relay either by opening the local circuit of the No. 2 sounder, by opposing the local batteries of the No. 1 and No. 2 sounders, or by introducing resistance in it during the time that the armature of No. 2 relay rests on its back contact point at the moment of no magnetism.

The first of these, illustrated in Fig. 9, is the invention of Mr. J. M. Moffatt. *E* is an extra polar relay inserted in the main and artificial circuits. By the use of springs attached to its armature or by other suitable means, such as reducing the number of convolutions of the coils, or by shunting them, the armature is not operated by the "small" portion of the distant battery, but by reversals of the entire distant battery. The local circuit of the repeating sounder *R S*, it will be seen, is connected with the armature *A* and the local contact points of the extra relay *E* in such a way that it is closed in either position of rest of that armature, but is opened while the armature is passing from one side to the other. The armature is given a slight bias to insure its remaining on one side while the smaller portion only of the distant battery is in operation. When the full distant battery is reversed the armature *A*, as remarked, is operated, and at each transit of the armature the local circuit of *R S* is opened at the point *X*. The extent of this transit is regulated by screws until the necessary time of opening to coincide with the falling away the armature of No. 2 relay from its front stop is obtained, so that when it touches its back contact point at the time of "no magnetism" it does not produce a false signal, its local circuit being open at *X*, as shown in the figure.

It will be obvious that the armature of the No. 2 relay *N R* will have started to withdraw from its front stop in response to the pull of its retractile spring *S*, at the moment of "no magnetism," before the armature of the extra polar relay *E* starts to change its position, inasmuch as the latter must wait for the effect of the distant reversal before moving; but the fact that it does start before the armature of *N R* reaches its back contact, affords an example of the rapidity with which, after all, the actual reversal follows the moment of "no magnetism," even on tolerably long overland lines. I have known this ingenious device to operate effectually in preventing the false signal, but the extra polar relay is more or less objectionable.

Fig. 10 illustrates the Van Hoevenbergh local arrangement. It is the invention of Mr. Henry Van Hoevenbergh and was used on all of the Baltimore & Ohio Telegraph Company's quadruplex circuits, and is now, I understand, the property of the Postal Telegraph Company. The theory of its operation is simple. The local batteries of the "neutral" relay *N R* and polarized relay *P R* are joined, as shown, and the connections are so arranged that when the armature of *P R* is in a position between its two contact points, as in the figure, the two local batteries *L B* oppose each other. Consequently, when the armature of *N R* falls back on its contact point, it does not produce the "kick" in the repeating sounder *R S*. The rheostat *R* is inserted to preserve the resistance in the local circuit equal when the No. 1 sounder *S* is not in the circuit.

In this arrangement the polar relay is operated by both the small end of and the entire distant battery, consequently, it the local batteries of the No. 1 and No. 2 sounders were made exactly equal, the result would be detrimental to the working of the No. 2 side, inasmuch as the No. 2 sounder would be demagnetized at every transit of the armature of the polar relay in response to reversals of the small end of the distant battery, at which time, of course, the armature of the No. 2 relay is on its back stop.

Consequently, in practice, the local batteries are

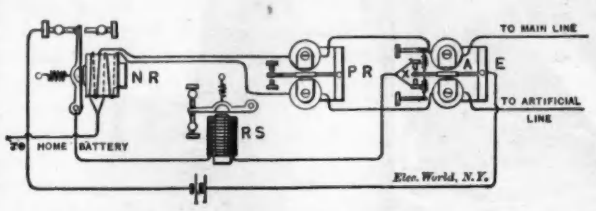


FIG. 9. IMPROVEMENTS IN THE QUADRUPLEX.

generally composed of four cells for the No. 2 sounder and two for the No. 1 sounder, which arrangement gives satisfactory results.

Besides the devices herein described, Prof. Van Ryselbergh, Messrs. J. W. Larish, S. D. Field, Geo. D'Infreville and others, have devised plans for the same purpose, from which it is plain that efforts to increase the efficiency of the No. 2 side of the quadruplex in this respect have not been wanting. Probably other inventors are yet to be heard from.

In the opinion of the writer, a promising method for still further increasing the efficiency of the phantom circuits may be found in a combination of Mr. Smith's condenser arrangement, or a modification of it, with the extra magnet and extended lever of the Prescott and Jones devices; or perhaps a modified combination of existing induction coil and extra magnet arrangements.

Theoretically this latter combination seems to answer the majority of the requirements, and if experiments in this direction hitherto have not been practically successful, it would appear to indicate that something in the practice is wrong.

The extra magnet and extended lever has this advantage over the third coil arrangement, that while the latter may, and does considerably, reduce the moment of no magnetism, it still leaves an instant during which it is possible for the retractile spring to act on the armature. On the other hand, with the extra magnet, as the main line core of the neutral relay loses its magnetism, the discharge from the condenser will, in a practical equally ratio, magnetize the extra magnet, and thus tend to retain the lever in its proper position during the moment of no magnetism in the core of the relay.

The use of the condenser for the purpose of obtaining the "bridging over" current appears to be superior to the induction coil, inasmuch as the condenser has a charge already accumulated which it discharges when the distant battery is cut off, while the induction coil does not begin to generate a bridging over current in the

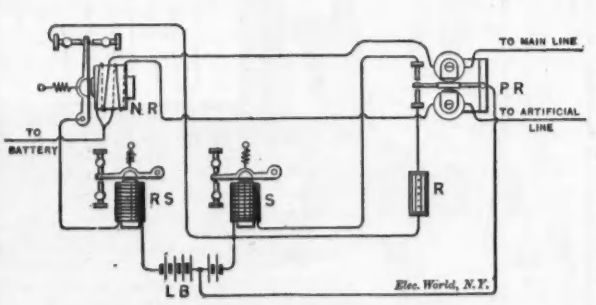


FIG. 10. IMPROVEMENTS IN THE QUADRUPLEX.

secondary coil until the main current subsides, and it may be said to cease with that current. But in either case the bridging over current can be prolonged in the extra magnet by well known means, if desired.

An article on improvements in quadruplex telegraphy would hardly be complete without a reference to the increased general efficiency in the working of quadruplex circuits which has followed the improved condition of the line wires, both as regards insulation and conductivity. Respecting the improvement in the latter quality hard drawn copper wire has played an important part.

The advantages accruing from the improvements in these respects have been such that quadruplex circuits are now worked without repeaters, in a commercially successful manner, to distances which a few years ago would have been considered almost impossible. Probably the longest quadruplex circuit now in existence is that between Richmond, Va., and Jacksonville, Fla., a distance of 745 miles, which circuit is composed of a No. 11 B. W. G. hard drawn copper wire having a total resistance of about 3,200 ohms. This circuit forms part of a "through" circuit between New York and Jacksonville, the "repeaters" of which are in Richmond. There are also a number of other quadruplex circuits in this country which closely approach this one in length.

Incandescent Lamps in Explosive Gases.

For some time past Lieut. H. Hutchins, United States Navy, has been carrying out a series of experiments at Newport, R. I., to determine whether or not incandescent lights may under some circumstances be dangerous for ship lighting. The following interesting results are given in his report:

Experiment No. 1.—By means of a station battery and a water voltameter, a sufficient amount of hydrogen and oxygen were collected to about fill an exercise torpedo case (G. P.) The fittings to the case were as follows: An entrance at the side to admit a steel rod for piercing the bulb; a window to ascertain whether or not the lamp was burning and a wooden frame to hold the lamp, the latter being inserted at the lower end of the case, which was open and under water. The explosion of a mixture of hydrogen and oxygen being violent, the case was lashed down so that it would not have to be held in position. A Swan lamp of 16 candle-power was used in this experiment, and the carbon filament was raised to a white incandescence from a dynamo. The lamp in its frame was introduced into the case containing the explosive gas, and the bulb was then pierced. The gas exploded immediately with considerable noise, completely shattering the lamp bulb, but not bursting the case. The carbon filament remained intact, probably due to the fact that the glass bulb was shattered into an innumerable number of small pieces.

From this experiment two points are evident. First, that the inrush of gas does not break the Swan filament before the gas has become ignited, and second, that in a highly-explosive gas the breaking of an incandescent lamp would be dangerous, at least, with a filament not less delicate than that in the Swan lamp.

Experiment No. 2.—Marsh gas is said to detonate when mixed with air, in the proportion of one volume of the gas to seven and a half volumes of air. The gas mixed in the above proportion was collected in a case similar to that used in Experiment No. 1. The same kind of lamp was used, and the experiment conducted in a manner similar to the preceding. The gas did not explode, and the filament was found to be broken, due, of course, to the flying pieces of glass.

Experiment No. 3.—Coal gas was used alone in this experiment, simply to observe the effect. The experiment was conducted in a manner similar to the preceding ones, except that a Maxim lamp was used. The result, on piercing the bulb, was that the filament continued to burn, the gas being probably decomposed, and carbon deposited on the filament in a manner similar to that in the "flashing test" in the manufacture of incandescent lamps.

Experiment No. 4.—In this experiment coal gas was used, mixed with air, in the proportion of one volume of gas to six volumes of air. A Maxim lamp was used, and the experiment conducted similar to the preceding ones, except that a pressure gauge was used to make certain, whether the gas exploded or not. For this gas being a weak explosive or not, the noise of the explosion might be faint. On piercing the bulb, the filament not having been broken by the inrush of gas, nor by the flying pieces of glass, the lamp continued to burn for a few seconds, then the required temperature being apparently reached, the gas exploded, making quite a noise. The tin case, not being lashed down in this experiment, was lifted five or six feet in the air, and the filament then broken by the force of the explosion.

It was considered unnecessary to experiment further with marsh gas, as the latter is even more explosive than coal gas.

As a result of these experiments, it is clear that the incandescent filament (provided it is as tough as either the Swan or Maxim filaments) coming in contact with either a highly explosive gas, such as a mixture of hydrogen and oxygen, or a comparatively weak one, such as coal gas and air in explosive proportions, will explode them. I am of the opinion, therefore, that when explosive gases are allowed to collect on board ship, from bad ventilation or other causes, incandescent lights, such as were used in these experiments, are dangerous for ship lighting.

Other experiments could, no doubt, be made that would be interesting, and perhaps valuable, in connection with this subject. For instance, it is claimed for the Edison lamp that the filament is always broken by the first inrush of gas. If this be true, there would appear to be more safety with the Edison lamp.

In connection with the first experiment, I would state that the precaution was taken to carefully solder the leads to the springs in the Swan socket, for otherwise an arc or spark might be formed, which would explode the gas, and would be misleading.

It will be remembered that a like test was made by Andrew Jamieson in Scotland some years ago, with similar results.

A New System of Alternate Current Motors and Transformers.*

BY NIKOLA TESLA.

In the presence of the existing diversity of opinion regarding the relative merits of the alternate and continuous current systems, great importance is attached to the question whether alternate currents can be successfully utilized in the operation of motors. The transformers, with their numerous advantages, have afforded us a relatively perfect system of distribution, and although, as in all branches of the art, many improvements are desirable, comparatively little remains to be done in this direction. The transmission of power, on the contrary, has been almost entirely confined to the use of continuous currents, and notwithstanding that many efforts have been made to utilize alternate currents for this purpose, they have, up to the present, at least as far as known, failed to give the result desired. Of the various motors adapted to be used on alternate current circuits the following have been mentioned: 1. A series motor with subdivided field. 2. An alternate current generator having its field excited by continuous currents. 3. Elihu Thomson's motor. 4. A combined alternate and continuous current motor. Two more motors of this kind have suggested themselves to me. 1. A motor with one of its circuits in series with a transformer and the other in the secondary of the transformer. 2. A motor having its armature circuit connected to the generator and the field coils closed upon themselves. These, however, I mention only incidentally.

The subject which I now have the pleasure of bringing to your notice is a novel system of electric distribution and transmission of power by means of alternate currents, affording peculiar advantages, particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power and will show that many results heretofore unattainable can be reached by their use; results which are very much desired in the practical operation of such systems and which cannot be accomplished by means of continuous currents.

Before going into a detailed description of this system, I think it necessary to make a few remarks with reference to certain conditions existing in continuous current generators and motors, which, although generally known, are frequently disregarded.

In our dynamo machines, it is well known, we generate alternate currents which we direct by means of a commutator, a complicated device and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilized in the motor, but they must—again by means of a similar unreliable device—be re-converted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor. In view simply of this fact, alternate currents would commend themselves as a more direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by such currents.

But the operation of the commutator on a motor is twofold; firstly, it reverses the currents through the motor, and secondly, it effects, automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the system, that is to say, the directing of the alternate currents on the generator and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presented itself, How to perform this operation by the direct action of alternate currents? I will now proceed to show how this result was accomplished.

In the first experiment a drum-armature was provided with two coils at right angles to each other, and the ends of these coils were connected to two pairs of insulated contact-rings as usual. A ring was then made of thin insulated plates of sheet iron and wound with four coils, each two opposite coils being connected together so as to produce free poles on diametrically opposite sides of the ring. The remaining free ends of the coils were then connected to the contact-rings of the generator armature so as to form two independent circuits, as indicated in Fig. 9. It may now be seen what results were secured in this combination, and with this view I would refer to the diagrams, Figs. 1 to 8*a*. The field of the generator being independently excited, the rotation of the armature sets up currents in the coils *c c*, varying in strength and direction in the well known manner. In the position shown in Fig. 1 the current in coil *c* is nil while coil c_1 is traversed by its maximum current, and the connections may be such that the ring is magnetized by the coils *c c*, as indicated by the letters *N S* in Fig. 1*a*, the magnetizing effect of the coils *c c* being nil, since these coils are included in the circuit of coil *c*.

In Fig. 2 the armature coils are shown in a more advanced position, one-eighth of one revolution being completed. Fig. 2*a* illustrates the corresponding magnetic condition of the ring. At this moment the coil *c* generates a current of the same direction as previously, but weaker, producing the poles n_1 s_1 upon the ring; the coil c_1 also generates a current of the same direction, and the connections may be such that the coils *c c* produce the poles *n s*, as shown in Fig 2*a*. The resulting polarity is indicated by the letters *N S*, and it will be observed that the poles of the ring have been shifted one-eighth of the periphery of the same.

In Fig. 3 the armature has completed one-quarter of one revolution. In this phase the current in coil *c* is a maximum, and of such direction as to produce the poles *N S* in Fig. 3*a*, whereas the current in coil c_1 is nil, this coil being at its neutral position. The poles *N S* in Fig. 3*a* are thus shifted one-quarter of the circumference of the ring.

Fig. 4 shows the coils *c c* in a still more advanced position, the armature having completed three-eighths of one revolution. At that moment the coil *c* still generates a current of the same direction as before, but of less strength, producing the comparatively weaker poles *n s* in Fig. 4*a*. The current in the coil *c* is of the same strength, but of opposite direction. Its effect is, therefore, to produce upon the ring the poles n_1 and s_1 as indicated, and a polarity *N S* results, the poles now being shifted three-eighths of the periphery of the ring.

In Fig. 5 one-half of one revolution of the armature is completed, and the resulting magnetic condition of the ring is indicated in Fig. 5*a*. Now, the current in coil *c* is nil, while the coil c_1 yields its maximum current, which is of the same direction as previously; the magnetizing effect is therefore due to the coils c_1 c_1 alone, and, referring to Fig. 5*a*, it will be observed that the poles *N S* are shifted one-half of the circumference of the ring. During the next half-revolution the operations are repeated, as represented in the Figs. 6 to 8*a*.

A reference to the diagrams will make it clear that during one revolution of the armature the poles of the ring are shifted once around its periphery, and each revolution producing like effects, a rapid whirling of the poles in harmony with the rotation of the armature is the result. If the connections of either one of the circuits in the ring are reversed, the shifting of the poles is made to progress in the opposite direction, but the operation is indentically the same. Instead of using four wires, with like result, three wires may be used, one forming a common return for both circuits.

This rotation or whirling of the poles manifests itself in a series of curious phenomena. If a delicately pivoted disc of steel or other magnetic metal, Fig. 9, is approached to the ring it is set in rapid rotation, the direction of rotation varying with the position of the disc. For instance, noting the direction outside of the ring it will be found that inside the ring it turns in an opposite direction, while it is unaffected if placed in a position symmetrical to the ring. This is easily explained. Each time that a pole approaches, it induces an opposite pole in the nearest point on the disc and an attraction is produced upon that point; owing to this, as the pole is shifted further away from the disc a tangential pull is exerted upon the same, and the action being constantly repeated, a more or less rapid rotation of the disc is the result. As the pull is exerted mainly upon that part which is nearest to the ring, the rotation outside and inside, or right and left, respectively, is in opposite directions. When placed symmetrically to the ring, the pull on opposite sides of the disc being equal, no rotation results. The action is based on the magnetic inertia of the iron; for this reason a disc of hard steel is much more affected than a disc of soft iron, the latter being capable of very rapid variations of magnetism. Such a disc has proved to be a very useful instrument in all these investigations, as it has enabled me to detect any irregularity in the action. A curious effect is also produced upon iron filings. By placing some upon a paper and holding them externally quite close to the ring they are set in a vibrating motion, remaining in the same place, although the paper may be moved back and forth; but in lifting the paper to a certain height which seems to be dependent on the intensity of the poles and the speed of rotation, they are thrown away in a direction always opposite to the supposed movement of the poles. If a paper with filings is put flat upon the ring and the current turned on suddenly, the existence of a magnetic whirl may be easily observed.

To demonstrate the complete analogy between the ring and a revolving magnet, a strongly energized electro-magnet was rotated by mechanical power, and phenomena identical in every particular to those mentioned above were observed.

Obviously, the rotation of the poles produces corresponding inductive effects and may be utilized to generate currents in a closed conductor placed within the influence of the poles. For this purpose it is convenient to wind a ring with two sets of superimposed coils forming respectively the primary and secondary circuits. In order to secure the most economical results the magnetic circuit should be completely closed, as shown in Fig. 10, and with this object in view the construction may be modified at will.

The inductive effect exerted upon the secondary coils will be mainly due to the shifting or movement of the magnetic action; but there may also be currents set up in the circuits in consequence of the variations in the intensity of the poles. However, by properly designing the generator and determining the magnetizing effect of the primary coils, the latter element may be made to disappear. The intensity of the poles being maintained constant, the action of the apparatus will be perfect and the same result will be secured as though the shifting were effected by means of a commutator with an infinite number of bars. In such case the theoretical relation between the energizing effect of each set of primary coils and their resultant magnetizing effect may be expressed by the equation of a circle having its centre coinciding with that of an orthogonal system of axes, and in which the radius represents the resultant and the co-ordinates both of its components. These are then respectively the sine and cosine of the angle α between the radius and one of the axes (*o x*). Referring to Fig. 11 we have $r^2 = x^2 + y^2$; where $x = r \cos \alpha$, and $y = r \sin \alpha$.

Assuming the magnetizing effect of each set of coils in the transformer to be proportional to the current—which may be admitted for weak degrees of magnetization—then $x = K c$ and $y = K c^1$, where K is a constant and c and c^1 the current in both sets of coils respectively. Supposing further, the field of the generator to be uniform, we have for constant speed $c^1 = K^1 \sin \alpha$ and $c = K^1 \sin (90° + \alpha) = K^1 \cos \alpha$, where K^1 is a constant. See Fig. 12.

Therefore
$$x = K c = K K^1 \cos \alpha;$$
$$y = K c^1 = K K^1 \sin \alpha, \text{ and}$$
$$K K^1 = r.$$

That is, for a uniform field the disposition of the two coils at right angles will secure the theoretical result, and the intensity of the shifting poles will be constant. But from $r^2 = x^2 + y^2$ it follows that for $y = 0$, $r = x$; it follows that the joint magnetizing effect of both sets of coils should be equal to the effect of one set when at its maximum action. In transformers and in a certain class of motors the fluctuation of the poles is not of great importance, but in another class of these motors it is desirable to obtain the theoretical result.

In applying this principle to the construction of motors, two typical forms of motor have been developed. First, a form having a comparatively small rotary effort at the start, but maintaining a perfectly uniform speed at all loads, which motor has been termed synchronous. Second, a form possessing a great rotary effort at the start, the speed being dependent on the load.

These motors may be operated in three different ways:

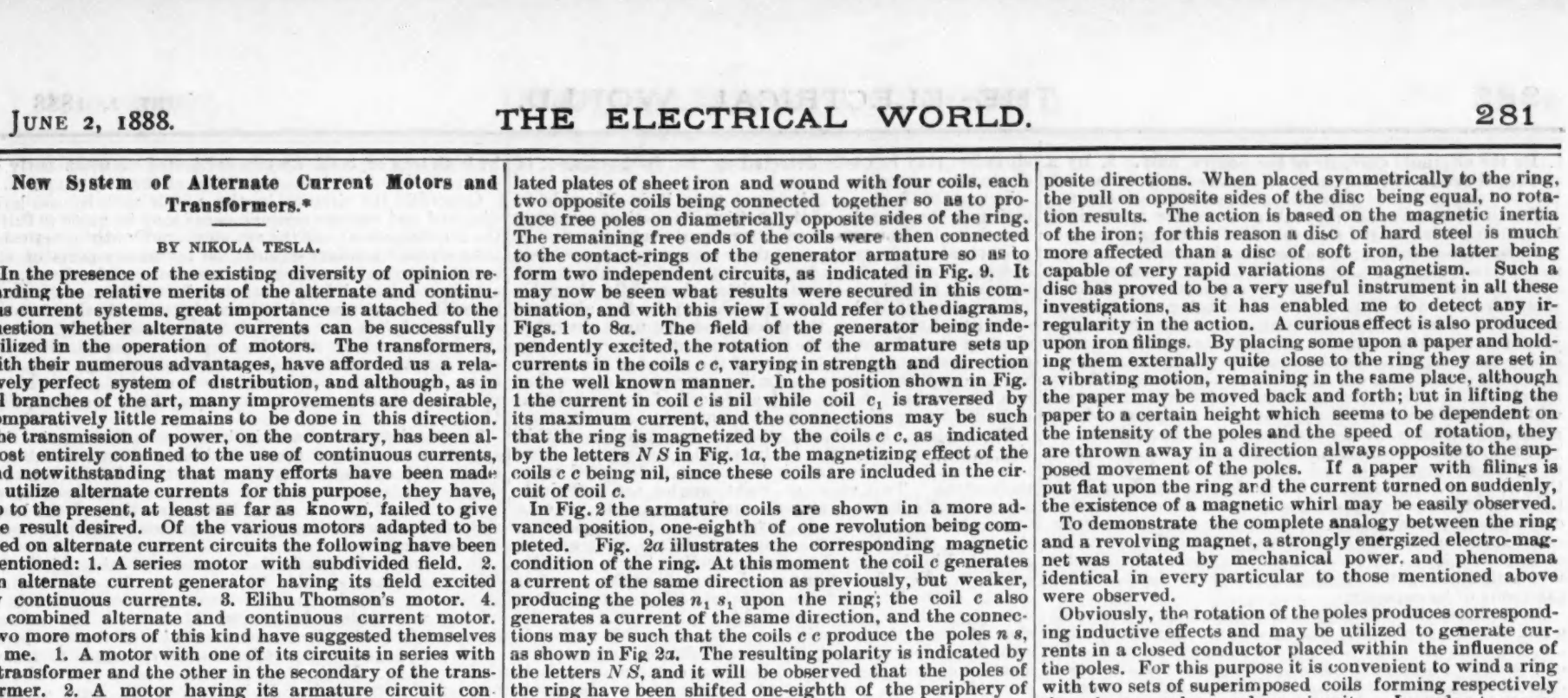


Fig. 1. Fig. 1a. Fig. 4. Fig. 4 a. Fig. 7. Fig. 7 a.
Fig. 2. Fig. 2 a. Fig. 5. Fig. 5 a. Fig. 8. Fig. 8 a.
Fig. 3. Fig. 3 a. Fig. 6. Fig. 6 a. Fig. 9.

A NEW SYSTEM OF ALTERNATE CURRENT MOTORS AND TRANSFORMERS.

* Read before the American Institute of Electrical Engineers, May 16.

1. By the alternate currents of the source only. 2. By a combined action of these and of induced currents. 3. By the joint action of alternate and continuous currents.

The simplest form of a synchonous motor is obtained by winding a laminated ring provided with pole projections with four coils, and connecting the same in the manner before indicated. An iron disc having a segment cut away on each side may be used as an armature. Such a motor is shown in Fig. 9. The disc being arranged to rotate freely within the ring in close proximity to the projections, it is evident that as the poles are shifted it will, owing to its tendency to place itself in such a position as to embrace the greatest number of the lines of force, closely follow the movement of the poles, and its motion will be synchronous with that of the armature of the generator; that is, in the peculiar disposition shown in Fig. 9, in which the armature produces by one revolution two current impulses in each of the circuits. It is evident that if, by one revolution of the armature, a greater number of impulses is produced, the speed of the motor will be correspondingly increased. Considering that the attraction exerted upon the disc is greatest when the same is in close proximity to the poles, it follows that such a motor will maintain exactly the same speed at all loads within the limits of its capacity.

To facilitate the starting the disc may be provided with a coil closed upon itself. The advantage secured by such a coil is evident. On the start the currents set up in the coil strongly energize the disc and increase the attraction exerted upon the same by the ring, and currents are generated in the coil as long as the speed of the armature is inferior to that of the poles. Considerable work may be performed by such a motor even if the speed be below normal. The intensity of the poles being constant, no currents will be generated in the coil when the motor is turning at its normal speed.

Instead of closing the coil upon itself, its ends may be connected to two insulated sliding rings, and a continuous current supplied to these from a suitable generator. The proper way to start such a motor is to close the coil upon itself until the normal speed is reached, or nearly so, and then turn on the continuous current. If the disc be very strongly energized by a continuous current the motor may not be able to start, but if it be weakly energized, or generally so that the magnetizing effect of the ring is preponderating it will start and reach the normal speed. Such a motor will maintain absolutely the same speed at all loads. It has also been found that if the motive power of the generator is not excessive, by checking the motor the speed of the generator is diminished in synchronism with that of the motor. It is characteristic of this form of motor that it cannot be reversed by reversing the continuous current through the coil.

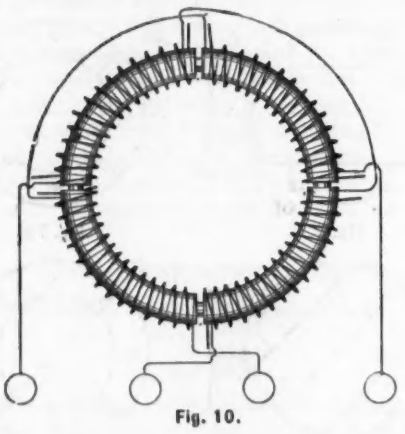


Fig. 10.

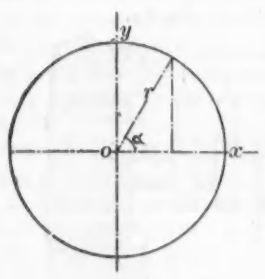


Fig. 11.

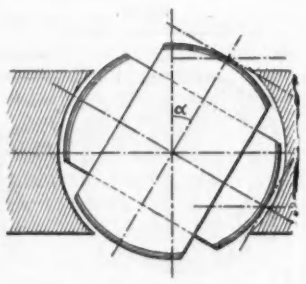


Fig. 12.

The synchronism of these motors may be demonstrated experimentally in a variety of ways. For this purpose it is best to employ a motor consiting of a stationary field magnet and an armature arranged to rotate within the same, as indicated in Fig. 13. In this case the shifting of the poles of the armature produces a rotation of the latter in the opposite direction. It results therefrom that when the normal speed is reached the poles of the armature assume fixed positions relatively to the field magnet and the same is magnetized by induction, exhibiting a distinct pole on each of the pole pieces. If a piece of soft iron is approached to the field magnet it will at the start be attracted with a rapid vibrating motion produced by the reversals of polarity of the magnet, but as the speed of the armature increases the vibrations become less and less frequent and finally entirely cease. Then the iron is weakly but permanently attracted, showing that the synchronism is reached and the field magnet energized by induction.

The disc may also be used for the experiment. If held quite close to the armature it will turn as long as the speed of rotation of the poles exceeds that of the armature; but when the normal speed is reached, or very nearly so, it ceases to rotate and is permanently attracted.

A crude but illustrative experiment is made with an incandescent lamp. Placing the lamp in circuit with the continuous current generator, and in series with the magnet coil, rapid fluctuations are observed in the light in consequence of the induced currents set up in the coil at the start; the speed increasing, the fluctuations occur at longer intervals, until they entirely disappear, showing that the motor has attained its normal speed.

A telephone receiver affords a most sensitive instrument; when connected to any circuit in the motor the synchronism may be easily detected on the disappearance of the induced currents.

In motors of the synchronous type it is desirable to maintain the quantity of the shifting magnetism constant, especially if the magnets are not properly subdivided.

To obtain a rotary effort in these motors was the subject of long thought. In order to secure this result it was necessary to make such a disposition that while the poles of one element of the motor are shifted by the alternate currents of the source, the poles produced upon the other element should always be maintained in the proper relation to the former, irrespective of the speed of the motor. Such a condition exists in a continuous current motor; but in a synchronous motor, such as described, this condition is fulfilled only when the speed is normal.

The object has been attained by placing within the ring a properly subdivided cylindrical iron core wound with several independent coils closed upon themselves. Two coils at right angles are sufficient, as in Fig. 14, but a greater number may be advantageously employed. It results from this disposition that when the poles of the ring are shifted, currents are generated in the closed armature coils. These currents are the most intense at or near the points of the greatest density of the lines of force, and their effect is to produce poles upon the armature at right angles to those of the ring, at least theoretically so: and since this action is entirely independent of the speed—that is, as far as the location of the poles is concerned—a continuous pull is exerted upon the periphery of the armature. In many respects these motors are similar to the continuous current motors. If load is put on, the speed, and also the resistance of the motor, is diminished and more current is made to pass through the energizing coils, thus increasing the effect. Upon the load being taken off, the counter-electromotive force increases and less current passes through the primary or energizing coils. Without any load the speed is very nearly equal to that of the shifting poles of the field magnet.

It will be found that the rotary effort in these motors fully equals that of the continuous current motors. The effort seems to be greatest when both armature and field magnet are without any projections; but as in such dispositions the field cannot be very concentrated, probably the best results will be obtained by leaving pole projections on one of the elements only. Generally, it may be stated that the projections diminish the torque and produce a tendency to synchronism.

A characteristic feature of motors of this kind is their capacity of being very rapidly reversed. This follows from the peculiar action of the motor. Suppose the armature to be rotating and the direction of rotation of the poles to be reversed. The apparatus then represents a dynamo machine, the power to drive this machine being the momentum stored up in the armature and its speed being the sum of the speeds of the armature and the poles. If we now consider that the power to drive such a dynamo would be very nearly proportional to the third power of the speed, for this reason alone the armature should be quickly reversed. But simultaneously with the reversal another element is brought into action; namely, as the movement of the poles with respect to the armature is reversed, the motor acts like a transformer in which the resistance of the secondary circuit would be abnormally diminished by producing in this circuit an additional electromotive force. Owing to these causes the reversal is instantaneous.

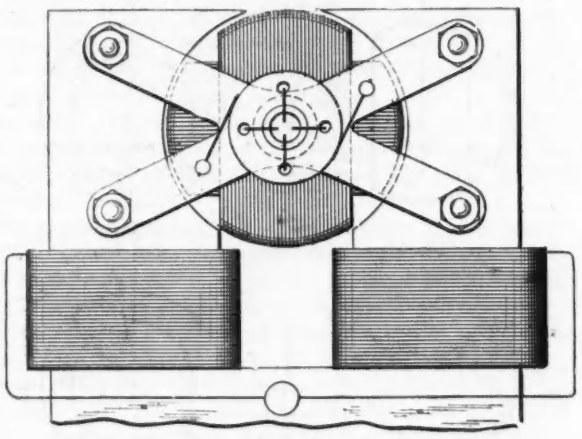


Fig. 13.

If it is desirable to secure a constant speed, and at the same time a certain effort at the start, this result may be easily attained in a variety of ways. For instance, two armatures, one for torque and the other for synchronism, may be fastened on the same shaft, and any desired preponderance may be given to either one; or an armature may be wound for rotary effort, but a more or less pronounced tendency to synchronism may be given to it by properly constructing the iron core; and in many other ways.

As a means of obtaining the required phase of the currents in both the circuits, the disposition of the two coils at right angles is the simplest, securing the most uniform action; but the phase may be obtained in many other ways, varying with the machine employed. Any of the dynamos at present in use may be easily adapted for this purpose by making connections to proper points of the generating coils. In closed circuit armatures, such as used in the continuous current systems, it is best to make four derivations from equi-distant points or bars of the commutator, and to connect the same to four insulated sliding rings on the shaft. In this case each of the motor circuits is connected to two diametrically opposite bars of the commutator. In such a disposition the motor may also be operated at half the potential and on the three-wire plan, by connecting the motor circuits in the proper order to three of the contact rings.

In multipolar dynamo machines, such as use the converter systems, the phase is conveniently obtained by winding upon the armature two series of coils in such a manner that while the coils of one set or series are at their maximum production of current, the coils of the other will be at their neutral position, or nearly so, whereby both sets of coils may be subjected simultaneously or successively to the inducing action of the field magnets.

Generally the circuits in the motor will be similarly disposed and various arrangements may be made to fulfill the requirements; but the simplest and most practicable is to arrange primary circuits on stationary parts of the motor, thereby obviating, at least in certain forms, the employment of sliding contacts. In such a case the magnet coils are connected alternately in both the circuits; that is, 1, 3, 5 in one, and 2, 4, 6 in the other, Fig. 15, and the coils of each set of series may be connected, all in the same manner, or alternately in opposition, Fig. 16; in the latter case a motor with half the number of poles will result and its action will be correspondingly modified, Fig. 17.

The employment of multipolar motors secures in this system an advantage much desired and unattainable in the continuous current system, and that is, that a motor may be made to run exactly at a predetermined speed irrespective of imperfections in construction, of the load, and, within certain limits, of electromotive force and current strength.

In a general distribution system of this kind the following plan should be adopted. At the central station of supply, a generator should be provided having a considerable number of poles. The motors operated from this generator should be of the synchronous type, but possessing sufficient rotary effort to insure their starting. With the observance of proper rules of construction it may be admitted that the speed of each motor will be in some inverse proportion to its size, and the number of poles should be chosen accordingly. Still, exceptional demands may modify this rule. In view of this, it will be advantageous to provide each motor with a greater number of pole projections or coils, the number being preferably a multiple of two and three. By this means, by simply changing the connections of the coils, the motor may be adapted to any probable demands.

If the number of the poles in the motor is even the action will be harmonious and the proper result will be obtained; if this is not the case the best plan to be followed is to make a motor with a double number of poles and connect the same in the manner before indicated, so that half the number of poles result. Suppose, for instance, that the generator has twelve poles and it would be desired to obtain a speed equal to $\frac{1}{7}$ of the speed of the generator. This would require a motor with seven pole projections or magnets, and such a motor could not be properly connected in the circuits unless fourteen armature coils would be provided, which would necessitate the employment of sliding contacts. To avoid this the motor should be provided with fourteen magnets and seven connected in each circuit, the magnets in each circuit alternating among themselves. The armature should have fourteen closed coils. The action of the motor will not be quite as perfect as in the case of an even number of poles, but the drawback will not be of a serious nature.

However, the disadvantages resulting from this unsymmetrical form will be reduced in the same proportion as the number of the poles is augmented.

If the generator has, say, n, and the motor n_1 poles, the speed of the motor will be equal to that of the generator multiplied by $\frac{n}{n_1}$.

The speed of the motor will generally be dependent on the number of the poles, but there may be exceptions to this rule. The speed may be modified by the phase of the currents in the circuits or by the character of the current impulses or by intervals between each or between groups of impulses. Some of the possible cases are indicated in the diagrams, Figs. 18, 19, 20 and 21, which are self-explanatory. Fig. 18 represents the condition generally existing, and which secures the best result. In such a case, if the typical form of motor illustrated in Fig. 14 is employed, one complete wave in each circuit will produce one revolution of the motor. In Fig. 19 the same result will be effected by one wave in each circuit; in Fig. 20 by two, and in Fig. 21 by four waves.

By such means any desired speed may be attained; that is, at least within the limits of practical demands. This system possesses this advantage besides others, resulting from simplicity. At full loads the motors show an efficiency fully equal to that of the continuous current motors. The transformers present an additional advantage in their capability of operating motors. They are capable of similar modifications in construction, and will facilitate the introduction of motors and their adaptation to practical demands. Their efficiency should

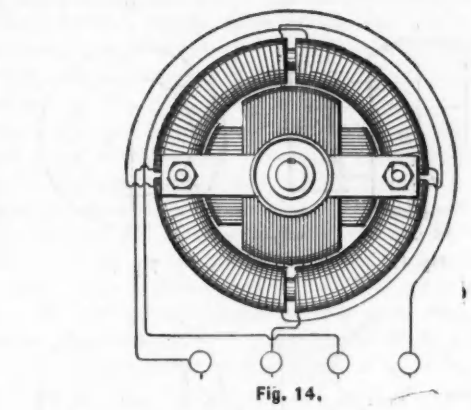


Fig. 14.

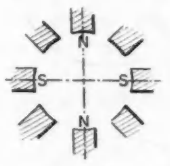


Fig. 15.

Fig. 16.

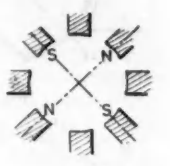


Fig. 17.

Fig. 18.

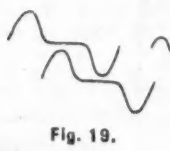


Fig. 19.

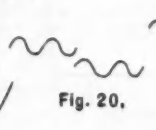


Fig. 20.

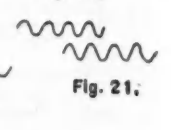


Fig. 21.

A NEW SYSTEM OF ALTERNATE CURRENT MOTORS AND TRANSFORMERS.

be higher than that of the present transformers, and I base my assertion on the following:

In a transformer as constructed at present we produce the currents in the secondary circuit by varying the strength of the primary or exciting currents. If we admit proportionality with respect to the iron core the inductive effect exerted upon the secondary coil will be proportional to the numerical sum of the variations in the strength of the exciting current per unit of time: whence it follows that for a given variation any prolongation of the primary current will result in a proportional loss. In order to obtain rapid variations in the strength of the current, essential to efficient induction, a great number of undulations are required and employed. From this various disadvantages result. These are, increased cost and diminished efficiency of the generator, more waste of energy in heating the cores and also diminished output of the transformer, since the core is not properly utilized, the reversals being too rapid. The inductive effect is also very small in certain phases, as will be apparent from a graphic representation, and there may be periods of inaction, if there are intervals between the succeeding current impulses or waves. In producing a shifting of the poles in the transformer, and thereby inducing currents, the induction is of the ideal character, being always maintained at its maximum action. It is also reasonable to assume that by a shifting of the poles less energy will be wasted than by reversals.

The Continuous Current, Limited, versus The Alternating Current, Unlimited.*

BY G. CUTTER.

You will see by the title of my paper that I declare my position more positively than my predecessors, and I do not claim to be impartial and then offer arguments all tending from one side of the question.

The tendency has been among the originators of central station systems towards high potential, not only in distributing electrical energy but in other departments of engineering, one of the most striking instances outside of our own special department being the high pressure hot water for distributing heat in Boston.

Mr. Abbott, chief engineer of this company, considers his problem simply one of distribution. This is the case with electrical distribution. It is simply the distribution problem, and the question is, the cheapest method of distributing the energy we sell.

That the continuous current has done a great work in the distribution of lights from central stations, none of us will deny, and that in certain cases it has been successful in spite of the limitations of such a method of distribution, we are also pleased to admit. The effort among the originators of central station systems has been in the direction of high potential. We are all more or less familiar with the many and various devices and methods that have been adopted to enable us to use high potentials in distributing our energy. This is not only the case in electrical work, but it is also the tendency in other classes of central station distribution. Outside of our own special department, one of the most striking instances is the system of distributing heat in Boston.

I do not wish to close the door on the continuous current nor on any department of electrical work whatsoever, as I wish for the greatest work possible with electricity, and stand ready to rejoice at the success of any method, be it with continuous current or without. I wish merely to show that in the present stage of our industry, the alternating current has decidedly the best outlook.

Mr. Leonard figures the cost of copper for the feeders of the three-wire system, and the copper and the converters in the converter system, and draws a very pretty diagram to show how far he can go with the continuous current three-wire system for the same money as with the converter system. The very best answer, to my mind, to these figures, is to have Mr. Leonard's customers ask him to put in the installation at the prices he gives. We will, in such a case, give him the advantage of the difference in price of copper.

One feature of this figuring is something I do not quite understand; for instance, in Table No. 3 of the Ward Leonard paper, it is stated, "that with 30 volts maximum loss, the cost of copper per lamp for the three-wire system at 6,000 feet would be $3.87." Then in his analysis of this table he calls this 6,000 feet "the average feeder length," and says this is equal to a circular area of 18,000 feet, or 3½ miles. How many times have I wished that the cost of copper for distributing on lamps was as elastic as this implies. Now, a radius of 18,000 feet circle is 9,000 feet. Mr. Leonard figures 800 feet between feeder terminals for his mains, and 100 feet from the mains to the lamps. We will suppose that half this distance between feeder terminals, 400 feet, and the 100 feet for the service wires are in a direct line with the feeder itself, thus making the feeder 6,500 feet long. I would like to understand how the cost of wires for a lamp 6,500 feet away can be the same with the same system as for 9,000 feet away. The relative cost of the wire under such circumstances being as the squares of the distances, I make it cut that the wire work for 9,000 feet costs about double that for 6,500 feet.

The continuous current advocates try to scare away the alternating current with the cry of "danger." To attempt this at the present day, in the face of the large amount of good work that has been done with high tension currents, is about like trying to mop out the ocean with a kitchen mop. The people who raise the cry, with few exceptions, do it for a check on the alternating current, not because they fear the danger they portray. If the danger is such as to preclude the high tension system, we might as well stop at that point and not bother to figure on the cost, depreciation, etc., of high tension plants. Their remarks, and the practices of the companies some of them represent, show that neither of them fear this danger. They are kind enough to say they think the converter system might be used as an adjunct to the continuous current plant to reach outlying districts beyond the limits of their favorite, but limited, system. If the alternating current is such a dangerous fellow as they try to prove, why should they advocate its use for outlying points, especially when such points would consist largely of residences? I must ask them if they would distribute lamps around the family hearth for servants and children to handle, with a system that is too dangerous to use in stores and offices? The converter was developed on purpose to enable us to reach customers at a distance, and still have the E. M. F. at the lamps reduced to a harmless quantity. By systems of installation already in use, the secondaries can all be made absolutely safe. The danger then is reduced to the primary wires.

Dynamos of 1,200 volts are run on three-wire sytem. I must therefore ask a direct question. Is a 2,400 volt system of distribution continuous current less dangerous than 1,000 volts alternating? If the tension of 1,000 volts is dangerous, why install and advocate systems of 2,400 volts?

I feel that I must raise another point to show that fear of high tension is assumed for city policy, and not philanthropy. Suppose we do not adopt the policy of grounding the secondary; and some transformer leaks. The individual secondary is thereby subjected to the same tension to ground as the primary, provided, of course, that the other ground comes on the opposite primary wire. On this secondary circuit may be put few lamps that people could handle. This is probable. Therefore the danger of such a leak only exists in a few lamps.

Mr. Leonard says, the best method of distributing the electric energy from a distant point is with the motor generator. Two 1,200 volt dynamos to be connected in multiple and the circuit carried to the upper story of some building where the motor generators are placed. From this upper story the regular three-wire low tension system is distributed Leave out the item of cost of the secondary system, and its limitations, but consider now the danger. If any one motor generator of the whole lot should leak, there would then be the danger of the 2,400 volt tension throughout the whole network. I quote Mr. Leonard: "The motor-generator for this work is ready for market, but it has been learned that the cost per lamp can be very materially reduced by increasing the speed."

The alternating current converter is, as Mr. Kennedy well said, "the simplest piece of apparatus imaginable," and it has no moving parts whatever, no increase of speed; therefore, the relative danger of leakage between the two converters is almost as one to infinity, in favor of the alternator. And still, the leak in the alternate converter endangers a few lamps only, whereas the leak in the motor generator endangers the whole network. Here is a company with able representatives facing their almighty dollar, and advocating a system in which a leak would give 2,400 volts throughout a network of wires, and then facing somebody else's dollar, and crying "danger" against a system in which a leak gives 1,000 volts to a few lamps, and even that danger can be eliminated.

When Faraday was showing some experiments illustrating his great discoveries, and showed how simple it was to produce the electric spark with his apparatus, the Dean said "he was sorry for it, as it put new power into the hands of the incendiary."

Gentlemen, when any new devices are put forth to the world there are always people who cry them down for one reason or another and generally the cry of danger is raised; but our progress is not checked in any such manner. These considerations lead me to believe that our continuous current friends do not fear the danger or consider it should hinder our progress beyond the limited field of the continuous current.

The alternating current requires no pressure wires, because of the facility of making a voltmeter which compensates for the variation in loads. As the alternator plant is operated with a very low percentage of drop, in this case I have figured on 2½ per cent. The difficulties of regulating for change of load are very slight, and the apparatus for accomplishing this is very cheap. Moreover, wherever regulators are used for alternating currents, they consume little or no power in doing their work—just the reverse of the continuous current regulators.

Whatever improvement is made in the 110 or higher voltage lamp, will also give a proportional benefit in the 50-volt lamp; briefly then, the 50-volt lamp will probably always be 25 per cent. better than the 110-volt lamp.

In distributing our energy we wish that system which will enable us to accomplish the most, and which will be readily adaptable to the various demands.

As Mr. Bliss has promised a paper on the continuous side of this question, I certainly hope he will give us figures that will enable us to understand how the dividends can be paid by the actual earning capacity of large central stations of the continuous system, not only because I wish to know positively that these enterprises are a sure success, but also for the benefit that such demonstrations will be to the alternating side of the question, because if that will pay which is so limited in its capabilities, we can certainly feel sure that another installation furnishing the same class of energy can pay still better by virtue of its greater flexibility and almost limitless possibilities.

Mr. Leonard says: "Cost of operating and maintenance of any system is certainly reduced if they can operate from one source of supply." The remark was made as applying to central stations, but it appears to me to apply also to accumulator stations, because they must be operated at low potential; therefore they must have many of these accumulutor stations, each one of which is of necessity equipped with many and various devices for regulating the feeders, etc. That attempts are being made to run lights from accumulator stations, we are all well aware, and hope, of course, that they will prove a success, but that remains yet to be proven. When they are perfectly developed, and supplied with all the regulating devices above mentioned which appear to be necessary, the possibilities of profit may disappear, and I am free to admit I am afraid they will.

The idea of converting our energy seems to be the prevailing idea to-day, and our electric journals are filled with illustrations, paragraphs, figures, etc., about some sort of a converter system, alternating converter, continuous current converter, accumulator converter, and advocating it, or trying to prove that their special system of conversion is the best. This is interesting, as it shows pretty conclusively the general feeling that the continuous current of itself is altogether too limited in its possibilities for the work that we have in hand all over the world to-day. Our industry is growing, and the people are not satisfied with working within just such prescribed limits. Hence the various devices that enable us to go beyond those limits, and the alternating current seems to be just the thing wanted for the purpose, as it does its work in a manner not accomplished by any other converter system.

Admitting that the continuous current may be made quite a success, it still can never be placed about town in all sorts of situations, and of all sizes, as can the alternating current converter. It is a machine more or less difficult to keep in order, being, as Mr. Leonard says, "run at a high speed," that necessarily means constant watching. Therefore, these converters must be used in secondary stations with low tension system distributed from them. This is also the case with the accumulator. It also requires a great deal of attention, and if used for central station distribution must be placed about town in secondary stations. As the network from each secondary station is low tension, we must still work on high percentage of loss; in order not to have too many stations, and this combination of low potential and high percentage of loss; means constant attention to the regulating devices: that is to say, every one of these secondary stations embraces more or less the difficulties of the present continuous current station. And, further still, the secondary network can give but a uniform electrical condition theoretically; therefore your continuous current, whether it is of the three-wire system, multiple series system, continuous current converter system, or accumulator system, is limited, and very much so, in its possibilities. Any use of them at all requires high engineering ability, and the very best of engineering ability can only accomplish a limited amount of work.

The alternating current is entirely a different sort of a fellow: extremely flexible and unlimited. It enables us to start small and grow with the demands, with but very little trouble in the calculations. The cost of the conductors being a very small part of the whole installation, it is easily determined what the installation will cost. Those of you who have made calculations for the continuous current plant, or have been called upon to furnish the necessary data for such a calculation, appreciate readily the difficulties involved, nearly all of which difficulties disappear the minute you begin to work with the alternating current. The change in the load of a considerable amount in one part or the other is readily taken care of by an ordinary man, and at no very great expense; possibly a little work for the expressman to carry a few converter boxes from one customer who has given up lights to another who has taken some on. There is no great bother about maintaining proper potential. The current will also furnish almost any phases of electricity desired. Instead of having a couple of wires in our rooms which will furnish 110 volts, and no more or no less, we have a couple of wires which will furnish any voltage, or most any quantity desired, so that if a new industry should arise where 8,000 or 10,000 volts are required, two little wires carrying the alternating current will furnish the energy which can be converted to this potential. Or, if a very large quantity is desired of low potential, these same two wires will furnish it.

For the rental of lights alone, the general impression has been that the alternating current can do it satisfactorily.

The work of motors on the alternating current has been discussed sufficiently before the Club, therefore we will await further developments in this direction. The alternating current motor is certainly further advanced to-day than was the continuous current motor when the work commenced with the continuous current distribution, so we will soon be able to rent power from our alternating network, provided it is found policy to do so from the electric lighting circuits.

There are other industries not before the world which certainly bid fair to become of great importance, and as one department has been pretty well developed, I will allude to that more particularly, and that is the welding and manipulating of metals by electricity. I have been fortunate enough to secure a number of samples of metals welded in this way, showing that I am not dealing in "futures" when talking of this industry. I believe that a large source of revenue to central stations that are providing alternating currents will be in furnishing the energy for this class of work. As it may be said that the continuous current is also being used for the welding of metals, I must say that this method has not proven a success, having seen the operation in a large work-shop in Paris, where they tried to make oil tanks by welding metals together with a voltaic arc. I know that the method is not at all a partial success as yet, as metal is oxidized and destroyed, burnt up, so to speak, by the intense heat.

The continuous current can be used for electric welding, but as enormous quantities of current are required the dynamo supplying the same must be near the work. This limits the continuous current very much for this class of work. Not so with the alternating current converter. We can attach on to our two little wires a very small converter for jewelry work, or a very large converter for heavy welding.

Another feature of the question is this, it is easier to work the registering meter on the alternating current than on the continuous current. The difficulty in this class of meter lies in the fact that they must record in proportion to the number of lamps burning, or the ampères used, whereas the work done is, by itself, in proportion to the square of the ampères. This difficulty is quite easily met in the alternating current by the use of a simple kicking coil, but it is not one easily met in the continuous current.

* Abstract of paper read before the Chicago Electric Club.

The Patent Court and Uniformity in Patent Office Practice.*

BY GEORGE H. STOCKBRIDGE.

In December, 1885, Mr. Montgomery, then Commissioner of Patents, rendered a decision in which he held that a process and a product, or any two "kindred and auxiliary" inventions might be claimed in the same application. This decision was a reversal of his predecessor's judgment in *ex parte Blythe* (C. D. 1885, page 82). Whereas Mr. Butterworth had held that by employing the language, "art, machine, manufacture, or composition of matter," Congress had defined in the law itself certain distinct classes of invention, Mr. Montgomery denies this, in effect, and holds as follows: "Inventions may be distinct and not separate and independent; even if so distinct, if they depend upon each other and mutually contribute to produce a single result, if they are 'kindred and auxiliary,' if they are in their nature or operation connected together, if they are connected in their design and operation, they may be claimed in one patent."

The office practice under Butterworth had been to deny the right of inventors to claim a process and a product, or a machine and a product, or a machine and a process (for these groups have always stood on the same footing) in the same application. The *Blythe* decision did not go

* Read before the American Institute of Electrical Engineers, May 16.

so far as to warrant this in direct language, but it was given that scope by the office.

Now, when the Montgomery decision in the case of *Young* was published, all this was changed. This decision also was interpreted somewhat differently from what its language would justify, but it led to the practice of combining in a single application duplicate sets of claims on the lines indicated. This practice continued nearly two years. During that time applicants and their attorneys filed, we will say, a thousand cases having claims based upon the *Young* decision. This was done with the clearest warrant, which was the office interpretation of *ex parte Young*.

On Oct. 19, 1887, Mr. Hall, the present Commissioner of Patents, took up the same subject and rendered a decision *ex parte Herr* (41 O. G., page 463), in which he says: "It must be regarded as settled by the very highest authority that an apparatus and a process are separate and distinct inventions. There is no requirement of law that they must or ought to be comprehended in a single patent, while there are many reasons why they ought not to be. A claim for a machine or apparatus and a claim for a process should be prosecuted in separate applications, and each, when allowed, should be comprehended in a single patent." There was no mistaking the meaning of this language. The result of it was that attorneys were notified, in the thousand cases I have mentioned, that the claims, or some of them, which they had filed in good faith and in accordance with the practice of the office, must be stricken out.

A secondary result was that inventors began to ask what their attorneys meant. "You told us," they said, "that we could cover both sets of claims by a single patent. What do you mean, now? Is this an attempt to squeeze us for another fee?" Well, of course, one had to explain. But the inventors then asked, "What does the *Office* mean? Is it possible that after fifty years no settled practice on this point has become established?" One had to answer, No. And in answering my own clients, I was led to consider just how safely such a statement might be made, and the result was the present paper.

Mr. Commissioner Hall expresses it in this way: "I approach the consideration of such a question with the greatest hesitation. It is one that has kept the attention of the office from its foundation up to the present day, and during the entire period there have been constant changes and variations of opinion on the part of Commissioners, contrariety of decisions and diversified rules."

I have not seen fit to go back farther than eighteen years, during which time there have been eleven commissioners of patents, and four or five acting-commissioners during the interregna. In 1870 Mr. Commissioner Fisher made a decision in case of *William Lowe* (C. D. 1870, page 39). In this case the inventor, who had been allowed claims for an apparatus, sought to obtain a second patent upon the process which was conducted through his apparatus. In deciding the case on appeal, Mr. Commissioner Fisher said: "The first answer to this claim is, that it cannot form the subject of a separate patent. It is not a distinct and separate part of the thing patented in the original. The furthest point to which the division of inventions has been pushed has been to grant one patent for the process and another for the product of that process. Such patents have, with some hesitation, been sustained (*Goodyear vs. Honsinger*, 3 Fisher, 150; *Goodyear vs. Wait*, 3 Fisher, 244; *Goodyear vs. Providence Rubber Company*, 2 Fisher, 510), but upon the express ground that this was a matter confided by law to the discretion of the Commissioner. But I have never known one patent to issue for a machine and another for the law or principle by which it operates. The mechanism of application is of no possible value except to carry out this process. Aside from this it possesses no patentable utility. The process is of no avail unless carried on through the medium of instrumentality. (*Morton vs. New York Eye Infirmary*, 2 Fisher, 324.) It would be idle to sell the patent for the mechanism and withold that which covers its legitimate and only mode of operation. Separate patents for processes and products have been justified upon the ground that the product might be imported, and a patent for the process would give no protection; but the machine and its mode of operation cannot be separated."

Mr. Fisher was a man of very positive opinions and he leaves no doubt regarding his views on the subject. But the views of his immediate successor, Mr. Leggett, are very different from his. (See *Murray vs. Wuterich*, C. D. 1873, page 96). He draws diametrically opposite conclusions from Judge Clifford's decision in *Goodyear vs. Providence Rubber Company*. Admitting that the Office practice allowed a "machine and its product to be claimed in the same application and go out in the same patent," he sums up as follows: "Notwithstanding the precedents which exist, and admitting that such a practice as they indicate, if not strictly correct, is not fatal to the validity of patents, I think the time has come, when, leaving out of consideration the perspicuity of the patents themselves, and the revenue to be derived under the law for examinations, a proper classification in the Office, so as to facilitate examinations and prevent mistakes in the issue of patents, requires that processes, machines and their products be presented for patent in separate applications."

Mr. Leggett resigned his office in October, 1874, and on the 23d of that month Acting-Commissioner Thatcher, in the case of Chamberlin (C. D. 1874, page 111) says: "All that can rightfully be claimed in this application is the machine and the link blank, which is the product of the machine." Here is plain evidence of difference of opinion. Mr. Thatcher evidently knows nothing about "a proper classification in the office, requiring that processes, machines and their products be presented for patent in separate applications."

I find no positive judgment of Thatcher on the subject, either while Acting-Commissioner or later, when Commissioner, nor of his successor, Mr. Duell, although Duell deals with a case in which process and product claims are combined (*Loeser*, C. D. 1876, page 104) without adverse comment.

The next decision is that of Doolittle, Acting Commissioner in 1877, in which he demands a division of the application of *Junker* and *Wolf*, on the ground that "the article is not necessarily the result or product of the action of the machine." This is in some sense a forerunner of Mr. Commissioner Spear's decision in 1878, which introduced a mode of treating such cases which prevailed for several years after him. His language is: "No rule of universal application can be given for this class of cases, more than for any other; but in each case, as it comes up for consideration, the inquiry must be made whether the process or machine and the products thereof are so separate and distinct that they must be called independent inventions."

This doctrine was affirmed by Mr. Paine in various decisions, notably in *Winterlich and others*, where he uses this language: "If the machine and the manufacture are so related that the former cannot operate without producing the latter and the latter can only be produced by the former, both may be united in one patent; but this is an exception to the general rule, which forbids the joinder of the machine and its product in one application.

Mr. Commissioner Marble, in *Bancroft* and *Thorn* (20 O. G., page 1,194), applauds the doctrine of his immediate predecessor and lets each case stand upon its own merits. Then came the Butterworth decision to which I have already alluded. He regards art, machine, manufacture and composition of matter as "statutory classes of invention." "Suppose," he says, "there be invented something in an art, or, as it is ordinarily called, a process, also a machine for carrying out the process, and also the manufacture or article which is produced in the operation of the process by the machine. There can be no doubt but that the statute calls for three patents for these three things. It makes no difference if they are invented simultaneously or successively, by one man or by three. Their independence remains the same."

Now let us see what changes of practice have been introduced by the various decisions to which reference has been made.

Mr. Fisher's decision seems to have been a new departure and to have altered the previous practice of the office. At all events, it fixed the practice under his administration and made it a positive requirement to combine claims for a machine and its product in the same application.

Well, what happens next? Mr. Leggett demands that such claim shall be separated, to facilitate the work of examination. That is change No. 2.

Mr. Thatcher and Mr. Duell appear to have allowed the two sets of claims to be combined, though I find no decision of theirs directly on the point. If I judge rightly of their practice, it may be regarded as constituting change No. 3.

It is certain that Mr. Spear and his successors, Mr. Paine and Mr. Marble, followed the practice of settling each case according to its own circumstances. Call this change No. 4.

Mr. Butterworth returned, in effect, to the practice of Mr. Leggett (change No. 5); Mr. Montgomery, in effect, followed Fisher (change No. 6), and Mr. Hall has now brought back the Leggett decision, thus introducing again a different practice from that of his predecessor in office (change No. 7).

I believe that if each commissioner had made himself the author of a new practice, there would have been three more changes than have actually taken place. However, I do not think more could have been expected. Really, this is very serious matter. The amount of annoyance and hardship imposed upon inventors in the way of unnecessary delay and expense is, in the aggregate, very great. I have no disposition to express an opinion as to which one, or whether any one, of the Commissioners has been right in his judgment on the matter in question. I have no doubt that the decisions in every case have been drawn up with a conscientious regard to the responsibility of the office from which the decisions emanated. But I do think that inventors and all who are interested in inventions have a right to protest against the continuance of a system which admits of and invites such unjust and arduous practices. It would not matter so much what the practice was, provided it were uniform, although of course it ought to be right and fair to inventors. But without uniformity it is monstrously unjust.

Lest it be thought that I have selected a peculiar class of cases, I may hasten to deny it in advance and may add that the office practice has been frequently altered on many matters quite as important. Take, for example, the question whether more than a single claim may be made in an application for a patent on a composition of matter. At least two commissioners have answered, No, and at least two more have answered, Yes. And so with many other cases. The mere fact that appeals have been taken to successive commissioners on the same subject indicate the condition of affairs in the Office.

What is the remedy for this evident evil? The best remedy yet proposed I conceive to be embodied in the bills recently laid before Congress by the Legal Committee of the National Electric Light Association. One of these bills provides that the salary of the Commissioner of Patents shall be $8,000 a year. I am not sure that the enactment of such a bill would not do away with two-thirds of the evils of the present state of affairs. It is probable at least that we should not have eleven Commissioners of Patents in eighteen years, and with less frequent changes in the head of the office, there would be necessarily less frequent changes in the office practice.

But there is still greater promise in the other bill which provides for the establishment of a Court of Patent Appeals, which shall have appellate jurisdiction from the Commissioner of Patents "in all cases touching patentability of inventions, priority of invention among several claimants for patent on the same invention, and the *judicial practice of the Patent Office*."

Such a court would be in the nature of the case a continuing body and its decisions would be little liable to change. The enactment of the last clause quoted would give it authority and set up what has never been set up before in connection with the Patent Office—a controlling and continuing authority, governing the actions of the Commissioner and, through him, of the primary examiners.

The Pronunciation of Dynamo.

To the Editor of The Electrical World:

SIR: Will you kindly publish in your next issue the correct pronunciation of the word dynamo. F. D. L. W.

ANSWER.—By unanimous vote, the National Electric Light Association at Baltimore in 1886 adopted "*dy*-na-mo" as the correct pronunciation of the word.—EDS. E. W.

The Mather Company.—The Mather Electric Company have changed the address of their Boston office to 105 Summer street, and that of the Chicago office to No. 11 Metropolitan Block.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, May 28, 1888.

The Mayor and the Wires.

New York has been very much interested during the past week in the attitude of the Mayor toward the Board of Electrical Control, and toward the jury now investigating the death of the lineman, Murray. Last week the Mayor was subpœnaed before the jury, but was so curt and uncommunicative, and so blunt in his refusal to "go around town on a fishing excursion" with the jury, that he was allowed to retire at his own will. The Mayor stated his opinion that the jury had nothing to do with the general question of burying the wires. Since that afternoon the Mayor has addressed a long letter to the Board of Electrical Control, setting forth various reasons for his failure to comply with the Board's request in regard to securing the removal of the wires and poles as street encumbrances. He believes that the electric light companies could take legal proceedings to prevent the Commissioner of Public Works from interfering with them in the discharge of their contracts with the city and with private consumers; but he states that he has already instructed the Corporation Counsel to move in the matter, and that perhaps a remedy for the present troubles may be found. The Board of Electrical Control, at its meeting last Friday, adopted a resolution expressive of its opinion that the Mayor has not given the Board the assistance necessary, and that he has not therefore done his duty.

Lighting Gedney's Channel.

The Bishop Gutta-Percha Company have received the contract for the cables to be used in lighting the buoys along Gedney's Channel, at the entrance to this harbor. There will be 32,000 feet required of 3-wire conductor to connect the first two buoys, and 15,000 feet of 1-wire conductor to connect the other four buoys with the 3-wire circuit. The return will be made on the stranded iron armor. The company report business as good, and I note that its new representative, Mr. W. J. Armstrong, is very actively engaged in and around the city explaining the merits of the many excellent specialties of the concern in the line of insulated wires, from the finest magnet wire to the largest cable that may be desired. The company naturally believe that their 40 years of experience ought to enable them to produce some very favorable results, and such results they show in the Marks compound insulation, Ballata flexible cords, switch and battery cords, rubber compound insulation and other varieties of products which are favorably known in all the different departments of aerial, underground and submarine work. I should add that the Edison Company have received the contract for the two dynamos, lamps, etc., necessary for the plant, and that E. P. Hampson & Co. have the contract for the steam plant.

Personal.

J. M. Pendleton, President of the New York Electrical Society, is the inventor of a system of police signaling which he claims is superior to the Herzog, recently adopted by the Police Commissioners. For his invention he claims surpassing economy, simplicity and efficiency. Mr. Pendleton says his system was not given a fair trial. The Herzog system will take, so Mr. Pendleton's representative stated, $375,000 from the city treasury, whereas Mr. Pendleton's would only cost half as much.—*N. Y. World.*

The Fulton Street Electric Railway.

The New York *Times* has the following: The defeat in Committee of the North and East River Electric Railway Company's bill throws that corporation upon the tender mercies of its old bugbear, the Bleecker Street and Fulton Ferry Railroad Company. It will be remembered that the North and East River Company under their franchise laid tracks through Fulton street from the North River to William street, where the Bleecker street line enters Fulton street and runs to Fulton Ferry. The North and East River Company relied upon the consent of the Bleecker Street Company for the use of its tracks from William street to the ferry, but the Bleecker street people wouldn't listen to it. In its traversal of the island the electric road had to run upon the tracks of two other companies, both of which consented thereto. They are the Central Park and North and East River Railway Company, and the Ninth Avenue and the Dry Dock, East Broadway and Battery Railroad Company. But the Bleecker street company would not fall in line, although the electric road offered to lay new tracks from William street to the ferry. Now that the legislature has failed to give the luckless company the relief it desired—that of amending the railroad laws so that the courts might have power to adjudicate the matter—the North and East River line is using every endeavor to get the Horse Car Association to champion its cause. The Horse Car Association, it is said, is disposed to favor the new road, and at its meeting next week an effort will be made to gain the consent of the Bleecker street company to allowing the electric road to use it tracks. If that consent is not obtained, and the Bleecker street line maintains its obdurate attitude, there is no alternative for the North and East River Company but to wait patiently until the next Legislature convenes and again present its bill for relief.

Electric Motor Manicure.

Miss A. F. Jett, "Manicure Artiste," eighth floor of the Equitable Building, this city, is using a C. & C. motor, with flexible conductor attachment, for buffing, polishing and trimming finger nails. Miss Jett is doing some very neat work in this department, and has already hit upon a number of improvements in the application, with the help of Mr. W. Wheeler, who has charge of the electric light plant, and I must say that this ingenious use of the motor has won my hearty admiration.

The Magnetic Club.

At a meeting of the Governing Committee, held on Tuesday evening (22), thirty-one new members were admitted, making a total membership of 82, the limit fixed by the constitution being 100. It was decided to hold the first regular meeting of the club on

July 11. The time and place have not yet been determined, but the sentiment of the members seems to be in favor of the seashore. The badge adopted by the club is in the form of a permanent magnet, bearing the telegraph signal expressing good will "73." Badges will be ready for delivery to members within a few weeks.

Ball Engines.

The Ball Engine Company, of Erie, Pa., have opened an Eastern office at No. 13 Cortlandt street, Room 62. This company has been forced to this move by the increased demand for their engines. Mr. Vincent, of the firm of C. R. Vincent & Co., who will be the manager, is a resident of Erie, has been engaged in the manufacture of engines for the past 20 years, and has been connected with the Ball Engine Company during the latter part of his stay in Erie.

A New Belt Holder.

A new belt holder and shifter, which has already found its way into a number of electric lighting plants, is "The Lightning," for which Willis & Schenck, 93 Liberty street, are the agents. It is reported to be a very convenient adjunct for dynamos and an excellent substitute for loose pulleys, etc. Some of these belt holders have now been in operation on the dynamos of the Citizens' Electric Light Company, of Brooklyn, for some time, and the company are, I am informed, very well satisfied with their working. The De la Vergne Refrigerating Company are using them on their dynamos, and speak well of them. Keuffel & Esser, the well-known mathematical instrument manufacturers, are using them on their dynamos in the Hoboken factory with equally good results. The belt holder is made entirely of iron, and is therefore unwarpable. All the parts are interchangeable.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, May 26, 1888.

Institute of Technology.

The senior electrical engineers of the Massachusetts Institute of Technology dined at Young's Monday evening, May 1. Mr. Geo. E. Claflin presided, and after the supper introduced the following gentlemen who responded most acceptably as follows:

"Our History," Russell Robb; "The Professors," E. F. Dutton; "Athletics," L. A. Ferguson; "Our Moustaches," D. A. Center; "The Ladies," W. H. Blood, Jr. Mr. F. P. Cheney, of Lowell, was present as guest, and gave some practical hints as to the prospects and position of the "Tech" man in business. Mr. H. W. Blake, with the Sprague Electric Motor Company, also gave a careful account of his latest and most remarkable invention, illustrating its spractical working by a model of excellent construction.

Fire-Alarm System in Boston.

The Massachusetts Legislature has passed a bill setting aside the sum of $75,000 from the liquor license fund for the further extension of the police alarm system in the city of Boston. A bill is also before the legislature providing for the severe punishment of any person who tampers or interferes with the police alarm boxes or wires or gives a false alarm.

The Municipal Signal System.

After a long and thorough competitive trial between the police alarm systems of the Gamewell and the Municipal Signal companies, the latter has been adopted by the Police Commissioners, and a contract has been awarded the Municipal Signal Company for the equipment of police divisions 3, 4, 9 and 15 in the city of Boston.

A Change in Name.

The Harris-Corliss Engine Works, heretofore conducted under the name of Wm. A. Harris, has by act of the General Assembly of the State of Rhode Island been incorporated, and is now styled William A. Harris Steam Engine Company. Mr. Harris, who established the business in 1864, is president and treasurer of the new company, and the works will be conducted and managed in the same manner as when run in his own name.

Personals.

Messrs. Geo. T. Manson, of the Okonite Company, of New York, and F. W. Harrington, of the Western Electric Company, of Chicago, were in Boston last week. The first-named gentleman favored this office with a visit.

Mr. Fred H. Angell, of The John A. Roebling's Sons Company, Trenton, N. J., was on a business visit to the "Hub" last week.

Col. H. S. Russell, of the Tropical American and Inter-Continental Telephone Companies, who has been absent in Europe more than a year, will sail for home about June 6.

Dr. A. H. Mason, general manager of the Simplex Electrical Company of Boston, who has been abroad for some time past, telegraphs his brother that he will sail from England for this city about June 6.

Mr. Leopold Schlegelmilch, president of the Schaefer Electric Manufacturing Company, has just returned to Boston after a trip in the Western States. Mr. Schlegelmilch reports the electric light business in the West as being active. His memorandum book shows a large number of new orders for the Schaefer lamp.

Mr. Henry W. Cooley, formerly of Lynn, Mass., has been employed by the Electric Gas Lighting Company, of Boston, as foreman of its factory. President Burnham has my congratulations on having secured the services of such a valuable worker.

Boston Electric Club.

The series of "Weekly Talks" on Wednesday evenings, at the Boston Electric Club, on electrical and other scientific subjects, inaugurated recently, are not only well attended, but already prove one of the most important features of that organization. On the evening of May 23 Mr. G. L. Lang, superintendent of telegraph of the New York & New England Railroad and president of the Association of Railroad Superintendents of Telegraph, entertained a large number of the members of the club with an extemporaneous speech on a highly interesting subject—"Electrical Appliances used by Railroad Companies."

Dinner at the Boston Electric Club.

On the evening of May 26 a most enjoyable entertainment occurred at the rooms of the Boston Electric Club. In addition to the dinner an intellectual treat was presented the members by Mr. G. W. Mansfield, manager of the Electric Railway and Motor Department of the Thomson-Houston Electric Company, who read an interesting and instructive paper treating on elevated railway systems and the adaptability of electric propulsion thereto.

Foreign Telephone News.

Advices from Rio Janeiro, Brazil, S. A., to the Tropical American Telephone Company, state that the dividend due that company on its "Rio" company's shares, and the amount of an invoice shipped over a year ago, have been collected. These together amount to more than the July, 1888, dividend already declared by the parent company. In addition to this the sales of telephone instruments and other apparatus by the parent company thus far the present year amount to more than double what they were a year ago.

Gages and Valves.

This particular line of supplies has found a ready market wherever a steam plant has been installed, and it is in the equipment of electric light stations that the very best make up of gages and valves is selected.

Among the most popular of the products named are those manufactured by the Crosby Steam Gage and Valve Company of Boston. This company has just issued a new catalogue—an artistic publication, elegantly bound and profusely illustrated—which will be mailed to any electric light company or superintendent of an electric light station or plant making application for it.

Vulcabeston.

Messrs. Chas. W. Trainer & Co., of Boston, are the New England agents for vulcabeston manufactured by the Johns-Pratt Company, Hartford, Conn. It is composed of asbestos, combined with water-and-acid-proof materials, vulcanized and compressed. At present the company makes two distinct kinds of vulcabeston; the first is acid and waterproof, and will withstand any degree of dry heat. This forms perfect and durable acid chambers, electric accumulator cells, etc. The fire and waterproof vulcabeston is a non-conductor of electricity, and possesses all the valuable qualities of the first, except that it is not acidproof.

Line Wire for Richmond, S. I.

The Electrical Supply Company, of Ansonia, has received an order for 56,000 lbs. of its P. and B. weather proof line wire from the Richmond Light, Heat and Power Company, of St. George, Staten Island, for the new circuits on which to operate the Thomson-Houston lights recently added to the plant.

Motors for Brockton, Mass.

Mr. H. C. Spaulding, of the Thomson-Houston Electric Company, says that the Eastside Street Railway Company, Brockton, Mass., after a thorough examination of the different systems of electric railways, voted at a recent meeting to adopt the Thomson-Houston.

Bridgewater, Mass.

Bridgewater proposes to light up soon by electricity. Thomson-Houston arc and Westinghouse incandescent systems are to be used.

W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, May 26, 1888.

The Chicago Telephone Company.

I referred last week to the Chicago Telephone Company, recently moved into their new building, corner of Franklin and Washington streets. The plant is claimed to be one of the most perfect ever constructed. Each operator has control over the wire of every subscriber in the main office system and can make a connection without calling upon a second operator, which obviates the necessity of repeating a call an indefinite number of times. The two districts known as "two" and "five" are consolidated. The increase of business and the necessity of giving the patrons better service made the consolidation imperative, and now it is claimed no city in the world will have better service than Chicago. Through the courtesy of Supt. Wilson, I am this week enabled to give a somewhat more detailed description of the plant. The building is seven stories high, besides a basement, and cost about $100,000. The site covers 3,600 square feet. The first story is built of Waupaca granite, the upper stories of pressed and moulded brick, the building being fire-proof throughout. The basement is used for steam heating, passenger elevators and also for storing some of the heavier classes of supplies. The first floor is used for a supply department, the repair rooms being on the second floor. On the third floor are located the general offices of the company, which are finished in an elegant manner. On the fourth floor are the headquarters of the Central Union Telephone Company. The toll line business is on the sixth floor, that of the city lines being on the seventh floor. Seventeen cables, each containing 200 wires, which converge there from all directions, enter the basement at the corner of Franklin and Washington streets, are carried along in an iron box to the rear of the building and thence to the second floor, where the underground terminals are located. At this point the seventeen cables cease to have a separate existence, each wire and each cable becomes attached to the corresponding office wire and these are grouped into 100 wire cables composed of a fine tinned copper wire, each one perfectly insulated. All of these cables are extended to the distributing board on the sixth floor, where are located the toll line department and switch-board. The distributing board is made of vulcanized fibre, has the appearance of cherry, and is preferable to vulcanized rubber. The wires after leaving the distributing board connect directly with the first section of the main switch-board, which is located on the sixth floor in a room designated as the "toll line" department, where all the lines extending out of the city to toll points centre. This section of the switch-board contains every city line entering the office, as well as all toll lines entering the city. Any call from a toll station to a subscriber in the city can be answered and connection made without the necessity of calling upon the operators in the main operating room, which is on the seventh floor. The subscribers' lines having passed from the switch-board, just mentioned, pass on upstairs to the second section, and thence through all the remaining sections, 18 of them in all, which extend along three sides of the operating room. This switch-board, the first section of which, as already mentioned, is located in the toll department, is of the multiple kind. The essential feature of the system lies in the fact that each operator has within her ready reach the spring jack or connecting plate of every subscriber whose wire terminates in the exchange, so that she can make any connection called for without the aid of any other operator, unless the connection required necessitates the use of a wire entering a branch office, in which case she must have the assistance of a trunk line operator. The switch-board is built in sections, each one containing a maximum of 200 subscribers. The number of lines positively connected with any section varies according to the amount of service required by the corresponding subscriber of such lines. For instance, if two operators sitting at a section can each make 700 connections during the day's labor, the number of lines actually connected with the section would be denoted by a total of 1,400. Each section is provided with two operators, with facilities for three in case of a rush of business. The assignment of lines to the various sections for operation is made by means of having an auxiliary distributing board located in the main operating department. Starting with the first cable of forty wires at the distributing board, thence they pass successively to each appropriate series of spring jacks in each section, thence each passes to the intermediate distributing board, and thence back to the section where the calls on this particular line are answered. These spring jacks are ingenious switches arranged so that by the insertion of a plug the wire connecting with the jack is switched off to other sections of the board, and the circuit diverted over the plug and its connecting cord, which in turn is in electrical connection with several wires; thus by the insertion of a plug corresponding with one wire into a spring jack corresponding with another, the desired connection of the two is made. When any connection is made by an operator in any section the effect is to virtually open or cut off the particular line connected with it from all the other sections in the exchange, the object being to prevent a second operator connecting with a line in use. Should a second operator undertake to connect with a line then in use she would receive an instantaneous signal indicating the use of such line in some distant part of the office, and reply to every call for such line that it was busy. If this signal is not received the connection thereupon is completed, and a similar signal will be produced on any other section should another connection be attempted. Whenever a subscriber has finished his communication it is expected that he will ring off. This ring throws the drop and indicates to the operator to disconnect, which she does by withdrawing the plug, after which connection with the same line can be made along any section of the switch-board. The equipped capacity of the switch-board is 3,000 lines with an ultimate capacity for 5,400. The switch-board has nineteen sections, but this number can be enlarged to meet the requirements of the business. Nearly 700 miles of wire in cable is used for the 3,000 subscribers. The top of the switch-board has an elevation of 81 inches; the space below for the plugs, cords and wires, 44 inches, and the highest spring jack is 60 inches.

The Baxter Electric Mfg. and Motor Company.

The Western branch of the Baxter Electric Mfg. and Motor Company was established in this city the early part of the year. The department is under the management of Mr. W. Whitney Munroe, with pleasant offices at 130 Dearborn street. At the time of the establishment of the office the motor business was practically in its infancy and many obstacles were encountered. The growth of the business has been steady and healthy. A power circuit was started Feb. 20 by the Chicago Arc Light and Power Company, since which time Mr. Munroe has received orders for equipping twenty-seven establishments with motors, including printing offices, clothing manufacturers, has manufacturers, shirt manufacturers, opticans, lapidaries, etc. Outside of Chicago, I am informed, considerable has been done in the motor business. At Milwaukee a power circuit has just been started, in which the Baxter motor will be used exclusively. At Grand Rapids, Mich., a power circuit has been started in which Baxter motors are to be used, some eight or ten orders having already been obtained. Mr. Munroe states that the business outlook in Milwaukee is exceedingly encouraging, and that they have every reason to anticipate as rapid a development as has been shown in Chicago. He also states that he is in receipt of individual orders from many western cities.

The Thomson-Houston Company.

The Thomson-Houston Company recently received an order for 50 arc lights to increase the plant at Cheboygan, Mich. They supplied the plant of their system at Houghton, Mich., last month with 30 additional arc lights and are now just in receipt of an order for 30 lights for further increasing the plant. They have also recently contracted with Hall & Buell at Bay Mills, Mich., to put an incandescent plant in their lumber mills, at that place. At Conneaut, Ohio, they are also putting in a central station incandescent plant of 300 lights.

United States Plants.

A resumé of the installations made exclusively by the Western Department of the United States Electric Lighting Company, shown me by Mr. C. C. Warren, the manager, gives a total of about 30,000 incandescents, and of 200 arcs. Below are only a few of the largest plants:

Texarkana Ice Company, 700; Swift Electric Light Company, 524; Syndicate Block, 800; W. T. Davidson, 600; Nelson & Weller Building, 750 and 20 arc; W. W. Towle, 500; Jaeggi & Schupbach, 500; Stillwater Electric Light Company, 500; Swift Electric Company, 500; People's Light and Fuel Company, 1,000; St. Paul Union Stock Yards, 600 and 20 arc; Jacob Dold & Son, 600; Anaconda Smelting Works, 600; Chippewa Falls Electric Light Company, 600; Haymarket Theatre, 1,175; Waukesha Am. Gas Company, 500; J. Banjan & Co., 500; V. Hirvrick, 500 and 20 arc; Chicago, Milwaukee & St. Paul Railroad shops, 500; Moffett, Hodgkins & Clark, 500; Twin City Gas Company, 500; Kankakee Electric Light Company, 500; Burlington Electric Light and Power Company, 500; Yankton Electric Ligh Company, 500 and 20 arc; W. H. Lukins, 500; Defiance Electric Light Company, 500; S. L. E. Company, East Saginaw, 500; Minnesota State Prison (increase), 600; Manistee, Mich., 500.

Electrical Supply Company.

I recently saw on exhibition at the Electrical Supply Company's store a handsome assortment of Geissler tubes. The Western branch of this company, which is located at Kansas City and under the management of Mr. C. H. Cone, has been removed to

pleasant quarters at 505 Delaware street. Business in that section is reported good.

Chicago Rawhide Manufacturing Company.

I found business brisk at the factory of the Chicago Rawhide Manufacturing Company this week. This company are the only manufacturers of rawhide belting in the country, besides which they manufacture a complete line of rawhide goods. They report an increased demand for their rawhide belting for running dynamos, the advantage claimed being that there is more grip than in other belting, and the belt can be easily cleaned with soap and water. They report inquiries regarding their goods from nearly all over the world, recent shipments having been made to Germany, London, Chili, Australia, Canada and Nova Scotia, besides to remote points in the United States. Besides the flat belt they also manufacture an endless belt from ⅛ to ⅜ of an inch in diameter, without lap or seam, for running generators for telephone purposes. They also manufacture endless rope of any desired size or length for power transmission purposes. They recently shipped a ton of this rope to Philadelphia. Besides manufacturing raw-hide belting, they manufacture blocks from which gearing is made for running motor cars, it having been used for some time on the Van Depoele railroad system. The special advantage claimed lies in the fact that it makes a noiseless gearing, is lighter than steel, and has better wearing qualities. The company has just issued a neat little catalogue, descriptive of goods manufactured by them, giving testimonials of users of their belting, besides containing some useful tables of interest, postal regulations, tables of wages and other valuable information. It is for gratuitous distribution, being sent free to any one who writes for it.

Synovial Oils.

Mr. S. Taussig, agent for the Synovial, Dynamo and Cylinder oils, reports business good in his specialty for this season of the year. He tells me of a 90-arc plant, including engine, dynamos, etc., which was run 17 hours per day for 50 consecutive days, using in all but 50 gallons of oil.

Electrical Roads.

Mr. W. A. Jackson, President of the Detroit Electrical Works, was in this city one day this week, on his return from a trip to San Jose, Cal., and other points in the West. At San Jose his company are putting in an electric road of the Fisher system. Mr. Jackson states that a portion of the road, some two miles, is now in successful operation, and that the remainder will be in operation in about two weeks. Some engineering difficulties have occasioned unavoidable delays, but the successful operation of the road is assured.

Leonard & Izard.

Leonard & Izard, agents of the Edison Company, have received the contract for installing 2,500 incandescent lights for the temporary lighting of the new auditorium, in which is to be held the Republican Convention next month. The firm have recently completed the installations of some of the finest buildings in Chicago. I recently saw a letter from the agent of the Phœnix Building, Mr. J. W. Carrington, which speaks well for the Edison light It states: "Your promise to make this a banner plant has certainly been redeemed, and the Phœnix building owes not much of its success and reputation for being the best equipped office building in the West." The firm has just issued a large handsome pamphlet on the Edison light, which, besides other things, gives a list of the Edison plants in Illinois, Wisconsin and Iowa, with testimonials from users.

A Cable and Conduit Company.

The Secretary of State this week issued license of incorporation to the American Cable and Electrical Conduit Company, Chicago; capital stock, $500,000; to construct and operate underground conduits, cables and electrical railways. Incorporators, Oliver Thomas Somerville, Graham D. Hazen, William R. Riley and Isaac I. Johnson.

The Shields & Brown Company,

Manufacturers of the well-known sectional insulated air covering for boilers, pipes, etc., report business for this season of the year far in excess of that of any preceding year. Among recent orders which they have just filled is one for the Edison Electric Light & Power Company of Erie, Pa. They have just completed the contract of the cementing for breechings of the plant of the Chicago Edison Electric Light Company, at their new power station on Adams street. The company have a covering especially adapted for use in electric light plants, and make a specialty of this kind of work.

A New Corporation.

The Western Light and Power Company, Chicago, was this week granted permission by the Secretary of State to incorporate, capital stock $100,000, to furnish electric light and power. Incorporators, William M. Talcott, Carlton Prouty and Frank Ives.

The Central Electric Company

are wiring the 100 rooms at Plank's Grand Hotel at Mackinac Island, Mich. Among recent orders received by this company was one for fifteen miles "Candee" wire of the large sizes.

Personal.

Mr. Maurice E. Bates, general superintendent Western Electric Construction Co., Kansas City, was in the city a few days last week on a business trip. Electrical business, he tells me, is very good in his section, his company being busy.

Mr. Jean A. Wetmore, general traveling agent of the Okonite Company, arrived in the city this week and is spending a few days here. He reports that matters pertaining to electrical industry are active, particularly throughout the South. The demand for Okonite wire and cables he says is greatly increasing, he recently having taken some large orders. The new lamp cord manufactured by his company, he tells me, is meeting the wants of the Southern trade.

Mr. Jas. R. Dee, of Houghton, Mich., was in the city a day or two this week. He reports business matters active in his section.

Mr. F. W. Horne, manager of the Western department of the Excelsior Co., who has been confined to the house with malaria for some little time past, is able to be out once more. He goes east this week on a trip of some weeks for the purpose of recuperation and to look after some business matters.

Mr. P. F. Kobbe, secretary of the United States Electric Company, is in the city for a visit of several days to the Western Department. Mr. Kobbe is making the trip for the purpose of recuperating his health and looking after the interests of his company in planning an aggressive campaign in the electric lighting field throughout the West. He states that there is a general feeling of satisfaction among the competitors of his company at the recent patent decision.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160@	$165	Iowa Union	$27@	$28
Central Union	47@	48	Michigan	79@	80
Chicago	375@	400	Missouri and Kansas	70@	71
Colorado	19@	21	Rocky Mountain Bell	40@	45
Cumberland	65@	68	Wisconsin	108@	109
Great Southern	35@	40		E. L. P.	

PACIFIC SLOPE NOTES.

SAN FRANCISCO, May 4, 1888.

The steamer "Queen of the Pacific," which was wrecked at Port Harford recently, is again afloat, but it will probably take eight or ten weeks to refloat her, at an expense of about $150,000 to $200,000. The electric plant consists of four dynamos: two Edison machines, operating incandescent lights; a Western Electric machine of six lights of 1,200 c. p., and a small United States machine supplying a 4,000 c. p. headlight. All these machines will have to be rewound. She is a very fine boat, and the renewals will take some time.

The Napa Electric Light Company have a contract for lighting the city with lamps of 800 c. p. on the Bell system. The contract includes the county buildings. Napa is the only city in California that has a central station incandescent plant. The system in this case is the Heisler, and the people are well satisfied with the light.

At Santa Rosa a half interest in the plant of the Pacific Coast Electric Construction Company has been sold. It is said that all the old machinery is to be taken out and replaced by Thomson-Houston dynamos and a Corliss engine.

The Electric Light and Power Company at San Bernardino is putting in a new waterwheel and dynamo with 40 lamps.

ENGLISH NOTES.

LONDON, May 16, 1888.

Edison-Swan vs. Anglo-American Brush Company.

The scientific testimony offered by the defendants in the incandescent lamp patent trial was brought to a conclusion with the examination of Mr. James Swinburne, the substance of whose evidence I gave you in my last letter. The whole of Thursday last week was occupied in the examination of a series of witnesses from Newcastle-on-Tyne, who deposed to having seen incandescent lamps made by Mr. Swan in the summer of 1879. One of the witnesses gave evidence to the effect that he had frequently carried crucibles for Mr. Swan to and from the kilns where they were subjected to the heat of the furnace; on one occasion he had seen Mr. Swan unpack the crucible and take from it a large quantity of charcoal powder and some carbonized filaments. Mr. Heaviside, who is the engineer in charge of the Northern District of the Post Office Telegraphs, deposed that he was a personal friend of Mr. Swan and had frequently assisted him in his experiments in the years 1879 and 1880. The progress which was being made by Mr. Swan with his lamps was a common subject of conversation at the Chemical Society of Newcastle, of which he was a member. Mr. Swan had at various times shown both the lamps and the process of manufacture to many members of the society, and he had never said a word to lead them to suppose that his communications were of a confidential character. Evidence of a very similar character was given by the six or seven witnesses who followed, and counsel then intimated that this closed the case for the defense. The plaintiffs thereupon asked permission to produce rebutting evidence, and Mr. Justice Kay inquired whether they proposed to place Edison himself in the witness-box, and appeared somewhat surprised at receiving a reply in the negative. On Monday morning Prof. Dewar was called to tender evidence on behalf of the plaintiffs. His examination lasted the whole of Monday and Tuesday. He described at great length a long series of experiments on the manufacture of lamps, which he had carried out in strict accordance with the directions given in the various specifications of Edison. In each case he had met with sufficient success to justify him in asserting that the specification was explicit enough in character and described workable processes. With regard to the much maligned tar-putty filament, which none of the witnesses for the defense had been able to construct, Professor Dewar exhibited specimens, both of the filaments and of lamps made by this process. The question of success he said was merely a question of manipulative skill. He had also been successful in carbonizing with sand, and he thought it a perfectly reasonable process. He denied that the term "carbonization" was not well understood at the time Edison made use of it; he denied also that either Sidot or Deprez had anticipated Cheesbrough's process of flashing.

"Magnetic Reluctance."

At a meeting of the Physical Society on Saturday last, Prof. Silvanus Thompson read an elaborate mathematical paper upon "The Conditions which Determine the Self Excitation of a Dynamo," in the course of which he took occasion to remark on Mr. Oliver Heaviside's proposal to employ the word "Reluctance" as a substitute for "Magnetic Resistance"; this he was inclined to adopt. In the discussion which followed, Lord Rayleigh also spoke favorably of the suggestion, and there appeared to be a general inclination to accept the term.

Messrs. Woodhouse & Rawson, Limited.

The firm of Messrs. Woodhouse & Rawson, which, after their defeat by the Edison-Swan Company in the action for infringement of incandescent lamp patents, was converted into a limited liability company, has since then become a very prosperous concern. At an extraordinary general meeting this week a dividend of 12½ per cent. was declared, which, together with the amount carried forward, showed a net earning for the half year equal to 40 per cent. upon the capital of the company. Unfortunately the truth must be told, and that is that this brilliant aspect of affairs is of a somewhat illusory character. There is good reason to believe that the actual electrical operations of the company have not been attended with any such substantial profit. The money has been made out of some financial transactions connected with the shares of a certain electrical automatic box company, in which Messrs. Woodhouse & Rawson have a large holding. Of course it is satisfactory to the shareholders to get their money from whatever source it may be derived, but it is to be hoped that this phenomenal dividend will not be laid hold of by the speculating community to forward their schemes.

Death of Sir Charles Bright.

The ranks of the early pioneers of submarine telegraphy are rapidly thinning. Last week I mentioned the death of Mr. T. R. Crampton, and this week it is my sad duty to record the death of Sir Charles Bright, whose name is probably as well known on your side of the water as it is on ours. He died very suddenly of heart disease while staying for the night at a relative's house. As age is now estimated, Sir Charles Bright must be considered to have been a comparatively young man, since he died within four years of sixty. At fifteen Sir Charles was at work on electro-telegraphy; in 1852 he became engineer to the Magnetic Telegraph Company, with which he was connected up to its extinction in 1870. But it is with the laying of the first Atlantic cable that the name of Charles Bright will be long remembered. Having satisfied himself that the scheme was feasible, he devoted himself thenceforth with untiring energy to its solution, and, ably supported by long-sighted men on either side of the ocean, the plan was carried through, and on the 5th of August, 1858, the shore end of the cable was landed in Valencia Bay. For this great service he received the honor of knighthood. From thenceforth Sir Charles was indefatigably engaged in cable enterprise all over the globe. In 1865 he became Member of Parliament for Greenwich, and in 1887 he was the elected head of the electrical world here, as President of the Society of Telegraph Engineers and Electricians. Sir Charles Bright was essentially an active practical man, and his work lay in the field rather than in the laboratory, though even there his labors were worthy of notice. It is, however, as the leading spirit in all cable enterprise that the name of Charles Bright will long live in electrical circles.

The Telephone Union.

Telephone combination and concentration is in the air. This week a meeting of representatives of the metropolitan and provincial telephone companies will be held in the metropolis, at which a final decision will doubtless be arrived at. The time for union seems to have come; threatened by the post-office, it is but natural that the telephone interest should take prompt measures to defend itself. Moreover, the telephone is rapidly becoming a universal necessity, and there is a wide demand for inter-communication, which necessarily involves a closer working than has hitherto obtained. Out of these cogent reasons comes the present plan of an all-embracing union. In a short time, therefore, London will be in telephonic communication with all the large towns of the Kingdom. The supreme control will be in London, and the general purse will provide for the trunk lines and extensions, each district being managed by subsidiary boards, as hitherto. The idea is to exchange the shares of the various companies for the scrip of the Telephone Union. The price paid for the shares will depend upon "the net earning power" of the companies, and may or may not equal their market value. There is to be no buying up of subsidiary companies, and no fresh issue of capital, except for the construction of trunk lines and extensions. The present called-up capital of the chief English companies is as follows: United, £447,000; National, £735,000; Lancashire and Cheshire, £380,000; Northern District, £195,000; Western Counties and South Wales, £355,000; South of England, £333,000; or a total of just 2½ millions sterling. A gigantic combination is thus foreshadowed. To what extent the public, as distinguished from the shareholders, will benefit by the change, is a matter of surmise. A monopoly of some description seems inevitable; it is simply a case of "Hobson's choice." Competition will be extinguished whether the Post-office buys up the telephones, or the various companies unite and present a firm front to all comers. The movement may, therefore, be regarded as, on the whole, beneficial to the public weal.

THE TELEGRAPH.

Western Union Bonds.—The new Western Union 5 per cent. bonds are being signed, and are expected to be ready for exchange for Mutual Union stock and bonds on July 1. In the exchange $5,000,000 bonds will be given for the Mutual Union bonds, and $2,500,000 bonds for Mutual Union stock.

Canadian Bucket Shops.—The new law suppressing bucket shops in Canada will, says a dispatch from Montreal, inflict a loss of at least $130,000 per annum upon the telegraph companies. The yearly contracts between the bucket shops and the companies for special wires are to be canceled.

Suing a Canal Company.—The suit of the Central and South American Telegraph Company for $35,000 damages against the Universal Interoceanic Canal Company of France for violation of agreement to relay telegraph cables in Panama Bay and for 19 days' consequent interruption of telegraphic communication, involving a loss of $28,000, has been transferred from the Supreme Court of the State to the United States Circuit Court. The canal company agreed to remove the telegraph company's cables from their original bed in order to cut a channel and make a new trench. The work was done, but the canal company declined to bear all the expense.

A New Telegraph Line.—A special dispatch from Lawrence, Mass., of May 21, says: The Commercial Union Telegraph Company, which has a line nearly completed between Boston, Lowell and this city, and which will be extended to Portland, petitioned the city government to-night for permission to run their lines and erect their poles through the city. The petition was referred to the Mayor, Alderman Butler and Davis, with full power, and the desired permission will be granted. The agent of the company, Mr. Crocker, says they will have an office open here in two weeks at the furthest, and will be in Portland by the 1st of August. The company has made an arrangement with the Postal

Telegraph line by which the former is able to reach all the localities in southern Massachusetts, and all national points west of New England. There is a great satisfaction expressed among all classes of citizens that the city will receive the benefit of competition in the matter of telegraphic business.

THE TELEPHONE.

An Exchange Burned Out.—Owing to a cross between the telephone and electric light wires, the exchange at Thirty-ninth street and Sixth avenue was burned out on May 23, about 10 P. M. Great damage was done to the switch-board and connections, and until the service can be restored the subscribers, numbering some 1,100 in that district, are cut out. It is thought that it will take two or three weeks to get the exchange in full running order again. The exchange has been in operation about three years. Messrs. Seely and W. A. Vail have been busy superintending repairs.

New England Telephone.—The New England Telephone and Telegraph Company has been incorporated at the State House with a capital of $25,000. William J. Denver is president, Fred J. Boynton, treasurer, the same and John W. Duxbury, C. Francis, A. Houston, directors. These gentlemen are all officers of the New England Telephone and Telegraph Company (the present company), which is a New York corporation. The new company is organized in the interest of the old company to perform certain acts and otherwise promote its interests in Massachusetts.—*Boston Herald.*

Bell Instruments.—The instrument account of the Bell Telephone Company for the month ended May 20 and five months is appended, and shows a steady gain of instruments in use :

Month May 20.	1888.	1887.	Increase.
Gross output	5,970	5,256	714
Returned	1,947	2,320	*373
Net output	4,023	2,936	1,087
Since Dec. 20.	1887-8.	1886-7.	
Gross output	22,925	21,692	1,233
Returned	8,955	9,516	*561
Net output	13,970	12,176	1,794

*Decrease.

A Race with the Telephone.—In its issue of May 25 the New York *Sun* makes note of a 10 minutes' competitive test between the telegraph and the long-distance telephone. The competition consisted in forwarding news matter from the *Sun* office to the Boston *Herald*. Mr. G. W. Irwin was the operator at the key and Mr. R. L. Holden forwarded through the telephone. When time was called it was found that the telephone had sent 346 words, while the telegraph had sent 330. It appears, however, that at the receiving end in Boston, while the telegraph message was received all right and in shape for the printers, the telephone message was taken with abbreviations that the printers could not understand. Hence the palm of this trial is awarded to the telegraph; but another race is to be arranged, and provision will be made for receiving the message in each case on the type writer.

THE ELECTRIC LIGHT.

Rome, Ga.—The Rome Gas Light Company has now put in a Thomson-Houston plant.

Tuscumbia, Ala.—The Sheffield Electric Light Company has made a bid for lighting Tuscumbia.

Dallas, Tex.—The Queen City Electric Light Company has applied for permission to put up a plant.

Harrisonburg, Va.—Mr. Pace, of Washington, D. C., has made application for an electric light permit.

Rome, Ga.—Mr. G. A. Hawkins, of Huntsville, Ala., is organizing a company to build an electric light plant.

Auburn, Cal.—A franchise for gas and electric lighting has been applied for by H. Disque, W. Lubecker and others.

Suffolk, Va.—Proposals for electric lighting may be addressed until June 15 to the council committee on public improvements.

Cartersville, Ga.—Mr. D. W. K. Peacock is interested in the movement for an electric light plant to do commercial and city lighting.

Annapolis, Ind.—The Annapolis Electric Light Company have bought a site for their station, and are now securing apparatus.

Zanesville, O.—Mr. J. C. Chilton, of Detroit, Mich., is interested in a movement to put in an Edison central station at Zanesville.

Pulaski, Tenn.—Mr. T. Y. Ryan is endeavoring to organize a company at Pulaski to put in an electric light plant, using the Silvey system.

Meridian, Miss.—Messrs. Coleman, Carley and others are making efforts to organize an electric light company to use the Jenney system.

Park Manor, Ill.—The Southside Electric Light Company has been incorporated by L. Allen and others, with a capital stock of $100,000.

Evansville, Ind.—The Citizens' Electric Company has been incorporated by A. Dyer, J. F. Kuhn, G. Brose and others, with a capital stock of $2,000.

Merchantville, N. J.—Proposals will be received till June 5, by D. Stetson, chairman of the Gas Committee, for gas works and an electric light plant.

Walla Walla, Wash. Ty.—An electric light and power company has been organized by C. B. Hopkins and others, who will build the plant at once.

Schenectady, N. Y.—The Lamp Committee of the Common Council of Schenectady are advertising for bids on a contract for 96 lamps of 2,000 c. p. for street lighting.

Sullivan, Ind.—The Sullivan Electric Light Company has been incorporated by C. L. Davis, M. B. Wilson, C. H. Crowder and others, with a capital stock of $15,000.

New Orleans, La.—The Consolidated Electric Light and Power Company has been formed, with a capital stock of $150,000, by H. M. Byllesby, J. S. Humbird, D. A. Tomkins, E. A. Farrar and others.

Washington, D. C.—Bids have been opened from the Brush, Westinghouse, United States and Edison companies for an incandescent plant in the Interior Department building. The award has not yet been made.

Toledo, O.—It is stated that over 3,500 lamps have already been subscribed for, to be supplied by the new Edison Company. Mr. J. Wright will have charge of the plant. The underground system, as usual, will be employed.

Foxboro, Mass.—At a recent town meeting at Foxboro the town voted to go back to darkness. The proposed electric light plant will not be put in and the town will take out the street lights that are already up. Foxboro must be a good place to move away from.

Brockville, Can.—The Gananoque Electric Light Company has offered to supply Brockville, Can., with twenty arc lights to run until midnight and twenty to run all night, and to light Victoria Hall, the council room and the clerk's office with incandescent lights, for $4,500 a year.

Atlanta, Ga.—The Georgia Electric Light Company, of Atlanta, is to erect a new brick station, 110 by 60 feet, 2 stories high, to which it will add a 120 h. p. boiler and a 100 h. p. automatic engine. The station is to be ready about July 1. The company is increasing its lighting capacity to 300 arcs and 800 incandescents.

Sawyer-Man Offices.—The general offices of the Consolidated Electric Light Company and of the Sawyer-Man Electric Company are now located at 510 West Twenty-third street, where all communications should be addressed. The offices of Capt. H. R. Garden, vice-president and general counsel, will remain in the Mutual Life Building, 32 Nassau street.

Bloomington, Ill.—The Bloomington *Sunday Eye* reports the Thomson-Houston plant in that place, of which Mr. J. H. Miller, from the Chicago branch, recently took charge, to be running very smoothly and successfully. There are now in operation nearly 300 arcs and over 800 incandescents. There is talk of the city buying this plant and station outright.

Harlem, N. Y.—Philip Braender, who owns five houses opposite the works of the Harlem Electric Lighting Company in One Hundred and Twenty-second street, near Second avenue, began suit for $50,000 damages against the company last week. He claims that the place is a nuisance and that the working of the machinery shakes the houses.

New York City.—A fire occurred last week at 60 Liberty street in a basement occupied by the Edison plant supplying some lights in that district. The place where the fire broke out was closed up, but the trouble is said to have arisen from a pile of greasy waste rags in one corner of the cellar. Considerable damage was done to the plant and building.

Wiremen's Badges.—Mayor Hewitt, of this city, has vetoed the ordinance passed by the Aldermen requiring the employés of the electric light companies to wear distinguishing badges while at work. He says the idea is a good one, but quotes an opinion of Corporation Counsel Beekman to the effect that such regulations lie only within the province of the Board of Electrical Control.

Sawyer-Man Lamps.—The Consolidated Electric Light Company has published a circular giving a complete list of the hundreds of plants in use burning Sawyer-Man incandescent lamps. The totals show that on Dec. 15 last year 308,302 lamps were in use under the Sawyer-Man patents, and that on April 15 their number had increased to 429,313, being an increase in four months of over 120,000 lamps.

Payne Engines.—Mr. H. J. Walker, Western department, Chicago, of B. W. Payne & Sons' automatic engines, boilers, etc., reports that general business in their line is good. They have recently shipped one 50 h. p. engine to the Menasha Electric Light Company, Menasha, Wis.; one 35 h. p. to the Johnson City Electric Light Company, Johnson City, Tenn, and one 60 h. p. to the Citizens' Electric Light Company, Horton, Kan.

Baltimore, Md.—R. G. Ward, 230 West Townsend street, Baltimore, Md., wants estimates, spot cash f.o.b. New York, dynamos to generate current for 4,000 16 candle-power incandescent and 100 arc electric lights; 5,000 16 candle-power lamps; 125 arc lamps; 10 miles of street copper; 10,000 feet of inside wire, with all requisite central station fixtures for a first-class plant, with specifications, exclusive of power.—*Baltimore Manufacturers' Record.*

Providence, R. I.—A special dispatch of May 21 from Providence says: The underground electric light plans had rather a set-back in the Common Council session to-night. The ordinances looking toward the placing of electric wires under ground were taken from the table, and, with the resolution creating them, were recommitted with the order for public hearings to be held. The resolution authorizing an application to the General Assembly for authority to hire $30,000 to put the city's electric wires under ground was indefinitely postponed.

Thomson-Houston Plants.—Mr. H. N. Curtis, of this city, has just made the following sales: A plant of 10 lights of 2,000 c. p. to Bloomingdale Bros.; a plant of 50 lights of 2,000 c. p. complete, for the pleasure resort of the Rome, Watertown & Ogdensburg Railroad Company at Windsor Beach and Sea Breeze, Lake Ontario, N. Y. He reports also that the New Rochelle Company is doubling its station room, putting in a second 100 h. p. New York Safety Steam Company's plant, and increasing its present dynamo capacity of 130 arcs and 500 incandescents, as soon as these other changes are completed.

Lighting New York Harbor.—A dispatch from Washington states that arrangements have now been perfected by the Lighthouse Board for the illumination of buoys in New York harbor, and that contracts for the work will be made at once. There will be six buoys lighting the channel and furnished with current from the plant at Sandy Hook light station. The plant is to cost altogether about $20,000, and the cost of the maintenance is put at about $3,000 a year. It is believed that when the arrangements have been perfected ships will be able to come through Gedney Channel as easily by night as by day.

The Thomson-Houston Company.—The Thomson-Houston Electric Light Company has lately increased its capital stock from $500,000 to $1,000,000, and it now sells at 65 per share. Stockholders took the new issue share for share at par, 25. The company has a factory employing 1,000 men at Lynn, and is doing a large business. Speaking of electricity as a motive power, an officer said he thought the cable road in Cambridge would be all that the West End Company would build, as he expected to see the electric conduit system used in Boston from preference. This system is in successful operation in Allegheny City, Pa., in connection with the overhead wire system.—*Boston Herald.*

Duluth, Minn.—The Duluth Electric Light and Power Company are installing a 600 light plant of the Westinghouse alternating system. The company met with considerable trouble in the preliminaries, but poles will be set at once, and Supt. Wm. Burges asserts that lights will be burning within two weeks. The Ohio Coal Company's dock is illuminated with ten arc lamps of the United States Company's manufacture. The Western Electric Supply Company is the title of a new organization of capitalists of Duluth. It is backed by some $300,000 of Duluth's private capital, and admirably prepared to furnish anything electrical. Mr. A. L. Croxton has been chosen manager and superintendent.

Belvidere, N. J.—A special dispatch of May 18 from Belvidere says: A meeting held in the Court House here last night to discuss the proposed lighting of the town by electricity broke up in a row. The meeting was called to discuss town affairs, and the promoters of the light scheme had packed the house with their sympathizers. Serious charges were made against the electric light people. They were in a majority, however, and voted down every proposition to investigate the company which proposes to do the work. The Common Council hold a meeting on Saturday night, when the matter will be further discussed. In the meantime, the excitement is intense, and many street disputes are the result.

Los Angeles, Cal.—The Electric Development Company, from their Southern agency at Los Angeles, Cal., report business as active. An Edison plant of 112 lights has been put in operation at the Los Angeles College for young ladies. They are operating 750 lamps of 16 c. p. (new) from the 500-light plant in the Pierce-Mosse building at San Diego. The call for the light continues, and a company is being organized for the installation of a central station to do the work. The station is to have a capacity of 3,000 lamps, and the capital stock of the company will be $150,000. Fall business in South California in electric lighting promises to be very good. Mr. W. E. Dennison is the manager of the Southern agency.

Olean, N. Y.—The Olean Electric Light and Power Company put its plant in operation last week, and is now giving very satisfactory service. The plant includes a Brush arc outfit, with a dynamo of 30 lights capacity, 2,000 c. p. All these lights have already been contracted for and placed. The steam plant comprises a 60 h. p. engine from Payne & Sons, of Elmira, and an 80 h. p. boiler from J. H. Luther & Sons, of Olean. The company will shortly start up the Westinghouse incandescent service, the work on which is already in hand. With the completion of the incandescent system, the plant will have cost about $25,000, all of which is local capital. The officers of the company are: president, J. V. D. Coon; vice-president, W. M. Irish; treasurer, F. L. Bartlett; secretary, F. A. Higgins; electrician, W. J. Doty; mechanicians, A. S. Newman and L. Hunter. The outlook is very encouraging, and the company anticipate a steady growth.

APPLICATIONS OF POWER.

Bristol, Tenn.—Messrs. Barker & Reynolds have begun operations for building their electric road.

Asheville, N. C.—A company formed by Mr. N. Atkinson will begin work at once upon an electric street railway.

Atlantic City, N. J.—It is reported that the Pennsylvania Railroad Company proposes to adopt electricity on its street car lines in Atlantic City.

Los Angeles, Cal.—The Los Angeles Daft road now has four miles in operation, and uses 280 gallons of oil a day under the Hazelton upright boilers in the generating station.

Fort Leavenworth, Kan.—A company, composed, it is said, of New York capitalists, has applied for a charter to build a street railway system of about 20 miles, to be operated by either steam or electricity.

New Rochelle, N. Y.—It is expected that the electric railway at New Rochelle with five cars operated with current furnished by the New Rochelle Electric light Company, will be running in June.

Topeka, Kan.—The Chicago Heights, Potwin Place and South Topeka Electric Motor Railway Company has been incorporated with a capital stock of $1,000,000, by H. D. Booge, J. R. Johnson, H. Taylor, A. H. White and J. F. Booge.

Little Rock, Ark.—The preliminary surveys and estimates are being made for a 10-mile extension of the electric street railway of Little Rock, of which the first division is to be put in operation as soon as possible. The engineer in charge of the work is Mr. F. J. H. Rickon.

New York City.—The Board of Aldermen, by a vote of 14 to 10, have refused to allow the Harlem Street Railway Company to operate Julien electric cars on its Fourth avenue road. These cars, when ready, will therefore be operated for the present only above Fourteenth street.

Des Moines, Ia.—A decision has been given in the Supreme Court of Iowa overthrowing the exclusive franchise of the old street railway company of Des Moines, operated by animal power. The new company which has been fighting for a foothold will operate by electric motors.

May be there is a Combine.—The action of 14 members of the Board of Aldermen in voting to prevent the New York and Harlem Railroad Company from running electric motors on their Fourth and Madison avenue surface road has excited suspicion

that there is a "combine" in the board similar in some respects to the notorious "combine" in the Common Council of 1884.—*N. Y. Times.*

Topeka, Kan.—The Garfield Park and Northern Heights Street Railway Company, with a capital stock of $50,000, is about to build a road which will be operated by electricity or other power not animal.

MISCELLANEOUS NOTES.

Boston, Mass.—The conduit wire bill has been lost in the Massachusetts Senate by a vote of 24 to 6.

Montreal, Que.—The Electric Construction and Power Company of Montreal is being organized by the Hon. J. J. C. Abbott, T. G. Shaughnessy and others.

"A Slap Dash Rule."—In Mr. H. C. Spaulding's "Slap Dash Rule for Wiring," given in our last issue, the constant for 110 volt circuits should be 13.3 instead of ⅓, as originally printed.

A New Engineering Firm has been formed by Mr. W. S. Turner and Mr. J. L. Woodbridge, as Woodbridge & Turner, of Cedar street, this city. Both gentlemen are well known as electrical engineers. They will undertake steam and electrical contracts and equipments of all kinds, especially of Edison lighting and Sprague motor plants and stations.

PERSONALS.

Mr. R. J. Pratt, of the Electric Manufacturing Company of Troy, N. Y., sails for Europe this week.

Mr. Thos. A. Edison is to contribute to the June number of the *North American Review* an article on the perfected phonograph. An authoritative statement of this kind will be very interesting.

Mr. W. S. Hill, of Boston, whose electric light system was recently illustrated and described in our columns, has just brought out an interesting little pamphlet on his system, prefaced by an article entitled "How Electricity is Generated in a Dynamo Electric Machine."

Lt. W. D. Weaver, of the U. S. S. "Omaha," has returned home from Japan recently, where he has been stationed for three years with that ship. Lt. Weaver is specially interested in electrical work, and is not slow to express his pleasure at the advances he finds to have been made.

Mr. Cushing, of the Chicago Arc Light and Power Company, is reported from the Pacific Slope to have been at the Coronado Beach Hotel lately on a flying trip in company with Mr. Swartout. Mr. J. C. Henderson, the general manager of the Electric Development Company, was at Coronado at the same time.

Mr. T. V. Powderly, the General Master Workman of the Knights of Labor, has addressed a letter to Mr. Rayner, Chairman of the House Sub Committee on Telegraphs, pointing to the fact that the petition for Government telegraphs received 1,000,000 signatures in four weeks, and claiming that 5,000,000 could have been obtained.

Mr. T. Carpenter Smith has resigned his position as superintendent of the Allegheny County Lighting Company, of Pittsburgh, to go into business as a member of the firm of M. R. Muckle, Jr., & Co., of Philadelphia, mechanical and electrical engineers and contractors. Mr. Smith will have the best wishes of a great many friends in his new departure.

Mr. H. C. White, who was recently connected with the engine firm of B. W. Payne & Sons, is now representing the Phœnix Iron Works, of Meadville, Pa., at 16 Dey street. The firm are building high speed automatic engines for electric lighting, and Mr. White has a number of them on exhibition. At the present time, Mr. White is expected from California after a two months' pleasure trip.

Prof. Alexander Graham Bell will sail for Europe June 2. He has been invited to appear before the British Royal Commission now engaged in making an inquiry into the best methods of caring for and educating deaf mutes. It may be remembered that several years ago Professor Bell presented a paper at a meeting of the National Academy of Sciences on the formation, through the inter-marriage of deaf-mutes, of a deaf variety of the human race, and gave some important statistics to show that a much larger percentage of the children of deaf parents are deaf than of those whose parents possess the sense of hearing. This paper attracted wide attention, and gave rise to very interesting discussions both here and abroad. The Royal Commission has requested Professor Bell especially to give to it the results of his subsequent investigations and studies upon this branch of the subject, and he has devoted much time to the preparation of facts and figures in regard to it. He will also give the commission the result of his studies of other divisions of the subject.—*Science.*

BUSINESS NOTICES.

Frames of every description for showcards and pictures can be had of William Levin, 37 Dey street. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

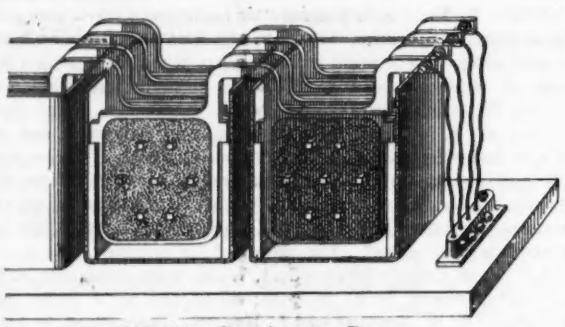
Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Small Domestic Electric Plants.—C. L. Levey, 49 Broadway, New York, is offering small plants with an automatic engine, etc., complete, at prices that reduce this light to one-quarter that of gas, the cost of maintaining 10 16 c. p. lamps being 14 cents for the lot for 4 hours. This is about one-quarter the price of gas.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 22, 1888.

383,095. Differential Expansion Device for Galvanometers; Wm. H. Bristol and William E. Geyer, of Hoboken, N. J. Application filed Feb. 24, 1888. The device is based upon the differential expansion of bars of the same metal but of different radiating surfaces. For full description see page 278, this issue.

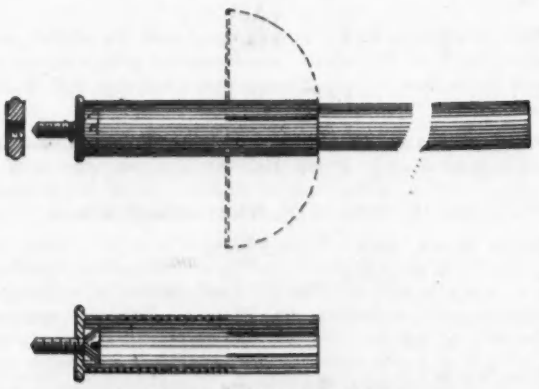


383,193. SECONDARY BATTERY.

(1) 383,097. (2) 383,098. (1) Support for Electric Wires; (2) Covering for Electric Wires and Cables; David Brooks, Jr., Philadelphia, Pa., Assignor to the Electric Cable Construction and Maintenance Co., of same place. Applications filed Dec. 4, 1886. (1) The ordinary clip and hook provided with an eye on the under side for a binding wire. (2) An electric cable formed of wires covered with fibrous material saturated with an insulating compound and a vulcanized rubber coating with interlying canvas wrappings.

383,105. Electrophorus; James D. Culp, San Filipe, Cal. Application filed Sept. 10, 1887. An electrophorus having two parts, one comprising the induced plate and the other the inducing plate and sole. Each plate is provided with a lateral extension which serves as a handle; the one on the induced plate is insulated therefrom, and that on the other has an exposed conductor connected with the sole.

383,113. Dynamo-Electric Machine; James W. Easton, New York, N. Y. Application filed March 18, 1887. This invention consists, in general terms, in providing the armature with a field magnet having poles of opposite character presented to different longitudinal portions of the armature and upon opposite sides thereof.



383,271. BATTERY ZINC

383,114. Automatic Tightening Device for Armatures of Dynamo-Electric Machines; James W. Easton, of New York, N. Y. Application filed April 13, 1886. In carrying out the invention there is placed within the armature a series of supporting-blocks which, when in position, form a cylindrical casing having a tapering or conical internal surface. Within these blocks there extends a tapering wedge, the outer surface of which conforms to the inner surface of the blocks. This wedge screws upon the armature shaft, and the thread upon the shaft is formed in such direction that the operation of the machine tends to screw the wedge within the circle of the blocks and expand them. See illustration.

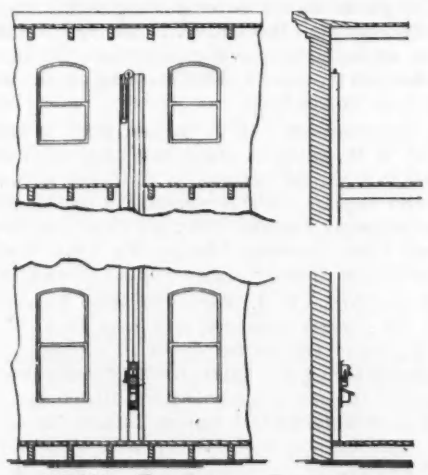
383,140. Manufacture of Incandescent Electric Lamps; Otto A. Moses, New York, N. Y., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Dec. 29, 1886. The globe and neck are made integral, the socket being screwed into the glass neck. See illustration.

(1) 382,158. (2) 383,332. Combined Gas and Electric Light Fixtures; Samuel B. H. Vance, of New York, N. Y. Application filed Jan. 31, 1887. Two separate conduits, one for gas and the other for wires, are joined together and work on the same joints.

383,150. Secondary Battery; Samuel Russell, Brooklyn, N. Y., Assignor to the Central Electrical Company of New York. Application filed Sept. 5, 1887. The plates have holes passing through them parallel to their sides.

383,184. Electrical Apparatus for Purifying Water; Albert R. Leeds, Hoboken, N. J. Application filed Sept. 19, 1887. Gas generated from a salt solution is passed in contact with water and is used to purify it.

383,193. Secondary Battery; John S. Sellon, Sydenham, County of Kent, England, Assignor to the Electrical Accumulator Company, of New York. Application filed Nov. 8, 1887. Patented in England Aug. 22, 1887, No. 11,448. Positive and negative plates are alternated in the cells, and each negative plate is independently connected to a positive plate in the adjoining cell. The latter are in the same plane, so that they may be removed without disturbing the remaining parts. See illustration.



383,269. TELEPHONE CONVEYOR.

383,216. Secondary Battery; Ludwig Epstein, Martinikenfelde, near Berlin, Prussia, Germany. Application filed Feb. 21, 1887. The electrodes consist of a series of composite strips, formed of the active material and metallic lead, the strips being arranged at a suitable distance apart, and connected by suitable means to form a grid.

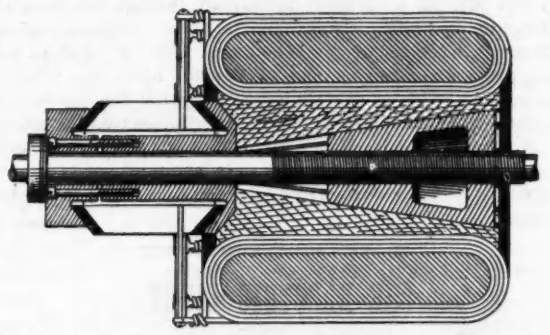
383,220. District Telegraph Call-Box; James B. Gill, San Francisco, Cal. Application filed Sept. 20, 1887. Details relating to the transmitting devices.

383,263. Galvanic Battery Excitant; Thomas P. Whittier, East Saginaw, Mich. Application filed Feb. 11, 1888. Residual salts from natural brine.

383,269. Telephone Conveyor; Samuel R. Ballard, Pittsburgh, Penn., Assignor of one-half to George V. Marshall, same place. Application filed Nov. 19, 1887. The telephone box, battery and all may be conveyed to different parts of a building for use. The device consists of an elevator shaft through which the telephone may be sent to the different floors of a building and still remain in circuit. See illustration.

383,271. Battery Zinc; John Beattie, Jr., of Fall River, Mass., Assignor to the Beattie Battery Zinc and Electrical Company of same place. Application filed Jan. 10, 1888. The device is best adapted to the pencil-zinc for open circuit batteries, and it consists of a cap of brass, copper, or other conducting material, shaped like a cartridge shell, and having a screw fitting into its head to receive the binding nut. The cap fits down tightly over the head of the zinc, and, while serving as a good connection, also preserves the head of the zinc from injury. See illustration.

383,273. Electrical Tramway; Henry T. Blake, of New Haven, Conn. Application filed June 2, 1887. The conductor is laid upon a strip of non-conducting material placed upon the surface, and is covered by a flap of non-conducting material which is adapted to be raised by the trolley to expose the conductor for the brush.



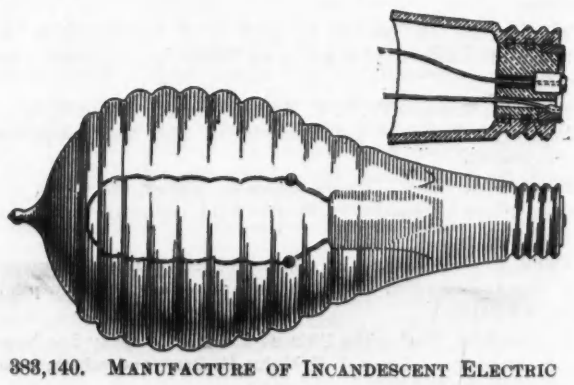
383,114. AUTOMATIC TIGHTENING DEVICE FOR ARMATURES OF DYNAMO ELECTRIC MACHINERY.

383,274. Electrical Tramway; Henry T. Blake, New Haven, and Clarence Sterling, of Bridgeport, Conn. Application filed June 28, 1887. The main conductor is buried in the conduit and the secondary is arranged above it, but separated by a flexible diaphragm. The plow or brush forces the two together.

383,320. Dynamo-Electric Machine; Lawrence N. P. Poland, Cincinnati, O. Application filed April 21, 1887. An iron shell includes the magnet and armature. The invention lies principally in a longitudinally grooved wooden armature which receives the plates of the laminated armature.

383,345. Rheostat; Frank J. Crouch, Eugene City, Oregon. Application filed March 31, 1888. The strength of current is varied by the amount to which the terminals of the circuit are submerged in a saline solution.

383,377. Fusible Coupling for Electric Fire-Alarm Circuits; George G. Smith, of St. Albans, Vermont. Application filed Sept. 1, 1887. A tube of fusible metal with the terminals of the circuit wire inserted in its ends has a weight fixed to the middle, which, when the tube becomes soft through heat makes a prompt break.



383,140. MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

383,411. Electric Lamp; Eli C. Ohmart, of New York, N. Y., Assignor by mesne assignments to the Ohmart-Homans Electric Lighting Company, of New York. Application filed March 6, 1886. For description see E. W. Aug. 28, 1886.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.